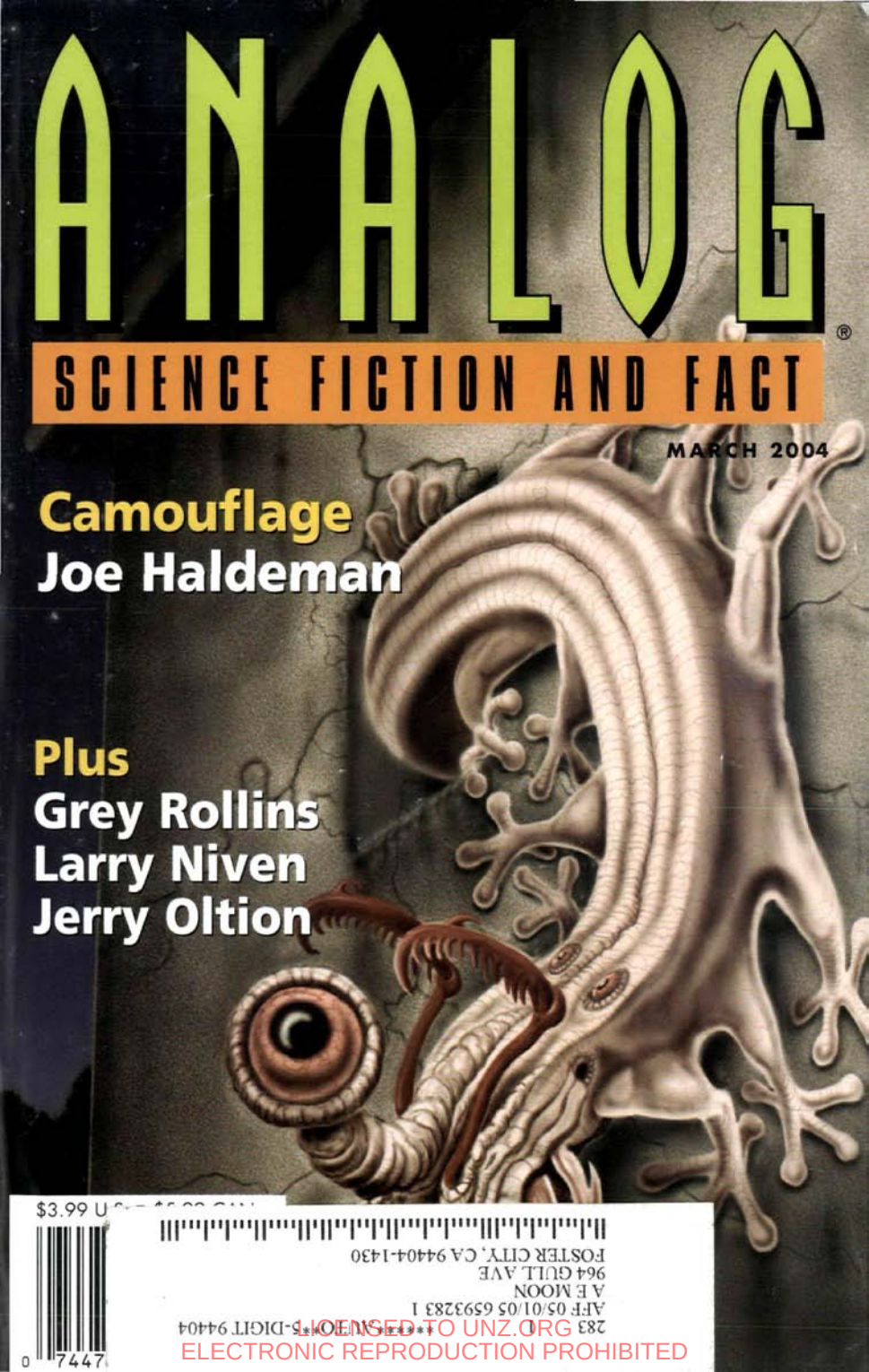
ANALOG

SCIENCE FICTION AND FACT

MARCH 2004



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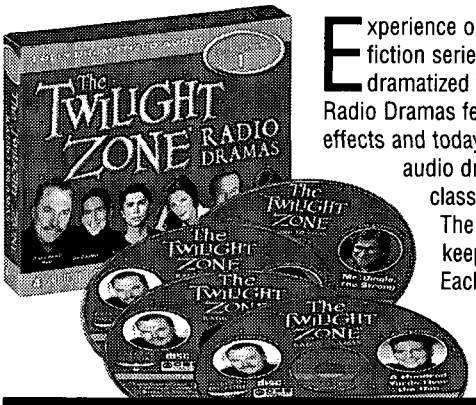

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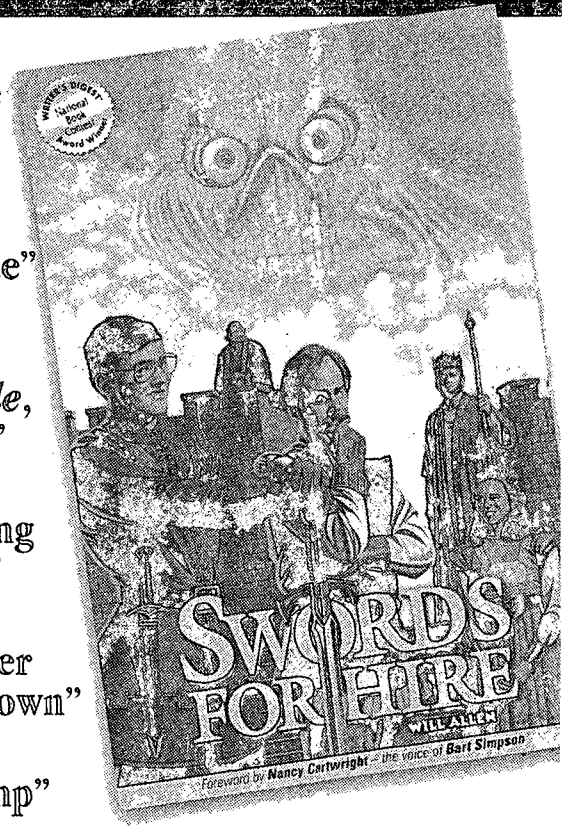
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March 2004

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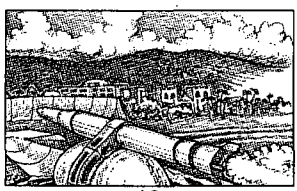

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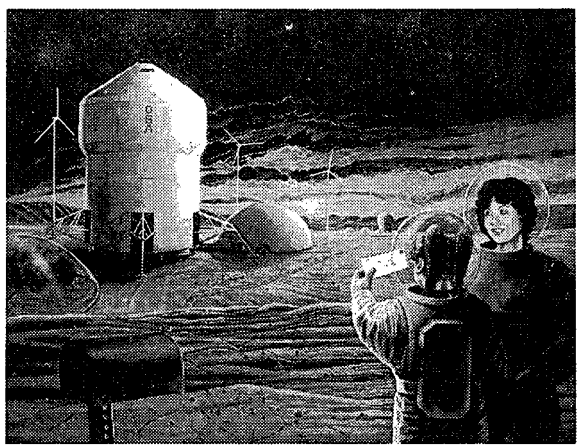

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ACHILLES' GRID

A couple of days ago I thought this was going to be about something completely different—in fact, I was well into writing it. But yesterday (i.e., the day before I started writing this) something happened that was a good reminder and object lesson about a couple of pervasive pitfalls in the way we're building our civilization. There's a good chance you experienced it, too, in your own way.

Last night I fully expected to be doing a first draft in longhand—something I've done very seldom in the last decade-plus—and the final copy on my usual computer, but driven by a generator started up just for that purpose. I got lucky, and things in my neighborhood got back to a semblance of normality more quickly than seemed likely. But I couldn't count on that, and even though I don't have the added drama of telling you I'm scratching this out with a ballpoint pen, the possibility was very real and the implied lessons still worth pondering.

Yesterday afternoon Joyce and I, starting home from a pleasant company outing on New York Harbor, had just boarded a commuter train in Grand Central Terminal. While we were waiting for it to pull out, the air conditioning and most of the lights went out. In itself, that's not alarming. Turning those things off for brief periods when a train is waiting to leave is a routine conservation measure. But when they were still off after several minutes, at scheduled departure time, I knew something was wrong. I expected an announcement that our train had a problem and we should hie ourselves to another one on Track So-and-So. Instead we were told that New York City had a power blackout and we should leave the train and wait outside until further notice.

That meant traipsing through the mostly dark cavernous interior of Grand Central (it does have minimal backup lights in the inside passages, and considerable skylight at 4:20 on a summer afternoon in the main concourse) and congregating outside the main entrance on 42nd Street. There was already a considerable crowd there, and it grew rapidly. Soon people were packed together like sardines all up and down both sides of the street and spilling out into it, waiting for some official diagnosis and prognosis that never came. No working lights could be seen anywhere along the street, so the outage obviously affected at least a sizable neighborhood. Many people were trying to make cell phone calls—so many that only once in a great while did one of them get through and elicit any information. Soon there were vague but fairly consistent reports that the entire eastern seaboard was affected, and some said the whole Northeast as far west as Ohio and north into Canada.

Meanwhile, the crowd continued to grow. Since there were no open spaces for it to expand into, that meant it grew still more dense. Fortunately it was a clear, generally pleasant day, but a hot one, and the temperature was still about 90° F. Several people around us succumbed to heat and anxiety and needed emergency medical attention; pretty much the same scene could be observed just about anywhere in the city. Some

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vehicular traffic still flowed, but not much, and more and more of it was emergency vehicles of all sorts going in all directions.

The first "helpful" announcement advised people to get water, but was vague about how that might be done. We had a little, but trying to get more seemed like a good idea. So I tried the restaurant across the street, which had an open door, lots of people inside, and just enough lights to suggest that it had a limited backup power supply. The bartender told me they'd sold out of bottled water, but he kindly gave me a couple of plastic cups of iced tap water, which I carried *very* carefully back across the street. We drank some, refilled the bottle in our pack, and guarded the rest jealously, sipping rarely but prepared to hand it over to any EMT who had an immediate need for it.

On the way, I noticed a reporter wearing a press badge and asked him what he knew. He confirmed that all power was out over a huge fraction of the Northeast, much as in the infamous Blackouts of 1965 and 1977. This confirmed our suspicion that this was not likely to be a small problem or fixed quickly. We'd already been out on the street a couple of hours, and spending the night there, with all the privileges and benefits that come with that, was beginning to look like a very real possibility. We began thinking about alternatives, which were few, none of them appealing. We lived much too far out to walk home; that would take days. We had friends in Manhattan who might let us try to sleep on their floor, though none of us could expect to be comfortable; but none of our attempts to contact them by cell phone succeeded. A bus from the Port Authority terminal might get us off the island, but nowhere near home—and only if they were running, which a policeman assured me they were not.

That seemed to leave one alternative to sleeping on the street: find a taxi driver willing to make a lengthy run out of town, and pay him a princely sum. We were among the lucky ones: we were actually able to do that. Less than an hour after we started trying, we managed to flag down a cabbie who stopped despite his OFF DUTY sign and asked where we wanted to go. When we told him, he understandably didn't want to do it. His day was supposed to be over, he had family visiting from out of town, and our destination was a long haul to an area he didn't know. Eventually he agreed anyway, after the specific promise of a very substantial tip and directions to and fro. Fortunately we had—just—enough cash to pay him. We considered it worth it, and were grateful for his willingness to do it at all. We were able to sleep, more or less, in our own beds; and while it seemed unwise to leave our backup generator and air conditioner running all night, they had already cooled things down to a reasonably comfortable starting point.

Analog Science Fiction and Fact (Astounding), Vol. CXXIV, No. 3, March 2004. ISSN 1059-2113, USPS 488-910, GST# 123054108. Published monthly except for combined January/February and July/August double issues by Dell Magazines, a division of Crosstown Publications. One-year subscription for $43.90 in the U.S.A. and possessions, in all other countries, $53.90 (GST included in Canada) payable in advance in U.S. funds. First copy of new subscription will be mailed within eight weeks of receipt of order. When reporting change of address allow 6 to 8 weeks and give new address as well as the old address as it appears on the last label. Periodical postage paid at Norwalk, CT and additional mailing offices. Canadian postage paid at Montreal, Quebec. Canada Post International Publications Mail, Product Sales Agreement No. 40012460. © 2003 by Dell Magazines, a division of Crosstown Publications, all rights reserved. Protection secured under the Universal Copyright Convention. Reproduction or use of editorial or pictorial content in any manner without express permission is prohibited. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental. All submissions must be accompanied by stamped self-addressed envelope, the publisher assumes no responsibility for unsolicited manuscripts or artwork.

POSTMASTER: Send change of address to: ANALOG SCIENCE FICTION AND FACT
6 Prowitt Street, Norwalk, CT 06855.

IN CANADA RETURN TO: Transcontinental Sub Dept, 525 Louis Pasteur, Boucherville, Quebec, J48 8E7
Executive Office: Penny Press, 6 Prowitt St., Norwalk, CT 06855
Editorial and Advertising: Analog Science Fiction and Fact, 475 Park Avenue South, New York, N.Y. 10016
Subscriptions: Analog Science Fiction and Fact, 6 Prowitt Street, Norwalk, CT 06855.

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Not everyone was so fortunate. Even among those who were able to get home, relatively few have their own generators (though we noticed as we drove home from the train station that our neighborhood, long prone to frequent local outages, has more than we'd realized). And many—*many*—weren't able to get home. Many New Yorkers could, but New York City is so big that it took some of them many hours and many miles of walking, much of it in the dark, to get there. And a great many people who work in New York City live dozens of miles away, a distance that simply can't be walked in one night. Hundreds of thousands, quite possibly millions, of them wound up sleeping on office or bus or train station floors, or right on the sidewalks. Some people, of course, do that anyway (a separate complex of problems). It's never recommended for those who can avoid it, but was probably safer than usual on Blackout Night because there were so many people doing it. And New Yorkers, perhaps because they've had so much practice, do have an admirable record of pulling together and helping each other in major emergencies.

But this was one was more major than most. Similar scenes occurred not only throughout New York City, but through 80% of New York State and large portions of eight other states and provinces. In some respects they were worse in New York City and its commuting environs, for a variety of reasons including sheer size and density and the fact that most of the city is built on islands, so all traffic in or out of a borough (especially Manhattan) must go through a few small conduits such as bridges or tunnels.

The morning after, New York's mayor was on television talking about how well people pulled together and got through the trying time (whose effects continued to be felt well after the restoration of power). He also mentioned that the incident provided a good lesson in the value of Being Prepared, e.g., with flashlights, portable radios, emergency food and water, and contingency plans. He was right, of course, but what I saw even more strongly was a couple of much bigger lessons that hardly anyone wants to confront or think about. After all, comparable widespread blackouts happened in 1965 and 1977, and by at least some measures this one was the worst. From one point of view, three times in almost forty years doesn't sound like a lot. From another, the fact that we're still making the same

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kind of massively disruptive mistake after that long doesn't speak well for our cultural learning curve. The important lessons I see in this are: (1) The danger of depending on technological infrastructures so huge and interconnected that a relatively small local fault can cause such massive inconvenience over such a wide area; and (2) The extreme vulnerability that is incurred by packing such high densities of people and businesses into such large concentrations as New York City.

Complete dependence on huge, massively interconnected infrastructures is already a pervasive tendency in our culture, and growing rapidly. The dependence on centrally produced and elaborately distributed electric power is just one example, although so far the most important because it underlies everything else. As the latest big blackout reminds us, when we lose the power grid, we lose almost everything else that we think of as basic parts of everyday life. And though many of us can cope with that deprivation for a little while, and joke about it and regale others with stories later, rather few of us have either the equipment or the personal skills to do without on a long-term basis. Part of the problem, of course, is that what we have come to think of as "basic parts of everyday life" has evolved far beyond basic biological necessities, and most of it is now largely artificial.

And, of course, while the power grid is the most basic large-scale infrastructure on which we let ourselves depend, it's rapidly being joined by others. Probably the second most important is already the internet and the vast number of documents and databases connected to it. Incidents like this summer's blackout, crippling both the power grid and the internet, are good reminders that the "paperless society" people used to dream of is really a bad idea; and even though some now joke about how far from achieving it we still are, we're probably too close for our own good. Digital media have tremendous advantages over hardcopy—when they're working. But when they become unusable, without hard copies you have nothing. And while "the nation's worst power outage" only lasted on the order of a day, it's all too easy to imagine other scenarios that would last far longer—up to and including "forever," as perceived by any individual human.

Yet most people continue galloping blindly toward the paperless future, either failing or overtly refusing to think about the potential pitfalls. Film photography, for example, is an industry which may well be teetering on the brink of extinction because so many of its former practitioners have forsaken it entirely in favor of digital photography. Certainly digital photography has big advantages, including the ability to see a picture right after you take it, the ability to store large numbers of images in a small space, and the ability to manipulate images to improve them (or lie with them). But it also has one huge disadvantage, which nearly everybody seems to ignore because it involves thinking beyond next year. One of the prime uses of photography has always been as a means of keeping records. Photos become valuable mementos of past experience, not only for the individuals who took them, but often for generations that follow them. Prints or slides can still serve that function after many decades, even if the technological infrastructure collapses completely and permanently. Digital photos would be completely lost (i.e., become unusable) in such a case—and are likely to be lost even sooner, even with no disaster, simply because rapid changes in technology will make it impossible to view old images with new equipment.[1]

So—letting too much of our lives depend on a huge, complex infrastructure that can be brought crashing down in nine seconds by a local failure in some part of it makes us vulnerable in a very big way. So does cramming vast numbers of us into places like Manhattan (or,

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on a smaller scale, many other urban areas). Manhattan is small enough that when you put millions of people into it, the number per square mile is very large—and so is the amount of supplies and services needed to support and clean up after them. Yet it's so large—especially when you consider the huge amount of additional urbanization in the surrounding boroughs and New Jersey suburbs—that it's a major undertaking to get them out when they want or need to leave. In a smaller urban area, most commuters can walk home in a few hours if they need to. In New York, millions of suburban commuters can't. So when something like the big blackout happens, you have way too many people in way too small a space, and no practical way to get them out. So they're stuck there, and if it goes on long, conditions go downhill fast.

What can be done about these problems? How can we continue to get the benefits of technology without building large vulnerabilities into the system? Most of the talk following the blackout centered on finding and patching the flaws that caused the collapse. That's certainly necessary, in the short term, but it may not be enough. Such approaches strike me as akin to sticking lots of thumbs into a dike when what's really needed is a new dike—or maybe a decision not to live where dikes are necessary. Sure, let's try to make systems less failure-prone; but we need at least as much effort to make system less vulnerable to failures, so that even if they do happen, the effects are limited. For example, backup generators or local plants should be able to take over at least partial loads when a problem happens in one area. Supposedly such a system was in place before this blackout, but parts of it failed. If that's the case, we need a better system that makes it even harder for a local problem to shut down a huge area.

Maybe we need a whole new kind of system for getting energy to where it's needed, and maybe we shouldn't take it as given that it has to start off at big generating plants and be distributed through a huge grid through which catastrophes can flow as easily as lifeblood. Finding a good alternative won't be easy, of course. A big grid offers economies of scale that small systems—at least the ones we have now—can't approach. (I have a generator, but don't like to use it any more than necessary because its power is far more expensive than what I buy from the public utility.) And when the grid is working right, it is advantageous to be able to shift power from areas with a surplus to those with a shortage. But the associated vulnerabilities are such that a way to avoid those while preserving the advantages would be even more desirable.

As for cities, they've been deeply ingrained in our way of life for thousands of years, but maybe they simply aren't a good system to continue into the future. They put too many people in one place where they're painfully dependent on an elaborate infrastructure for the most basic needs, and when that structure fails, they can't even get out. Maybe cities aren't necessary any more. But what is the alternative?

Really solving these problems is likely to involve conceiving fundamentally new ways of living, and then figuring out how to get to them from where we are. That's just the kind of job in which science fiction writers have often excelled. Our job is "advance scouting," imagining the general shape of solutions that might become possible in the future. And just maybe, some young readers of those visions will be inspired to figure out how to implement them. ■

[1] Yes, *some* would still be available, if paper copies had been made. But nobody makes paper copies of *all* their digital photos, because storing them would take too much room. Conventional prints take a lot of room, too, but slides are relatively compact and immune to shifting technologies.

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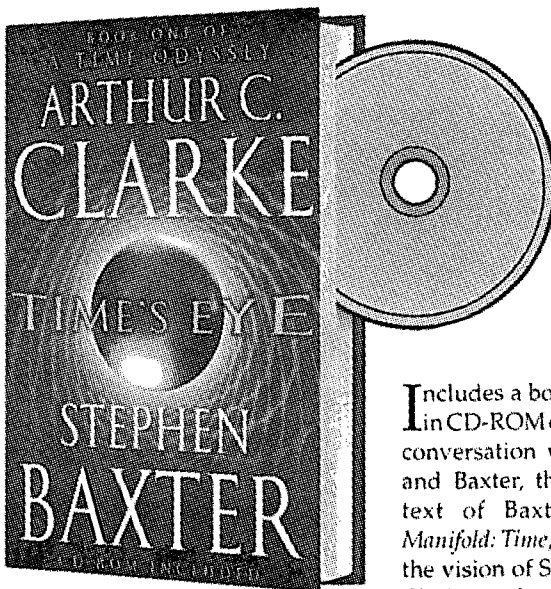

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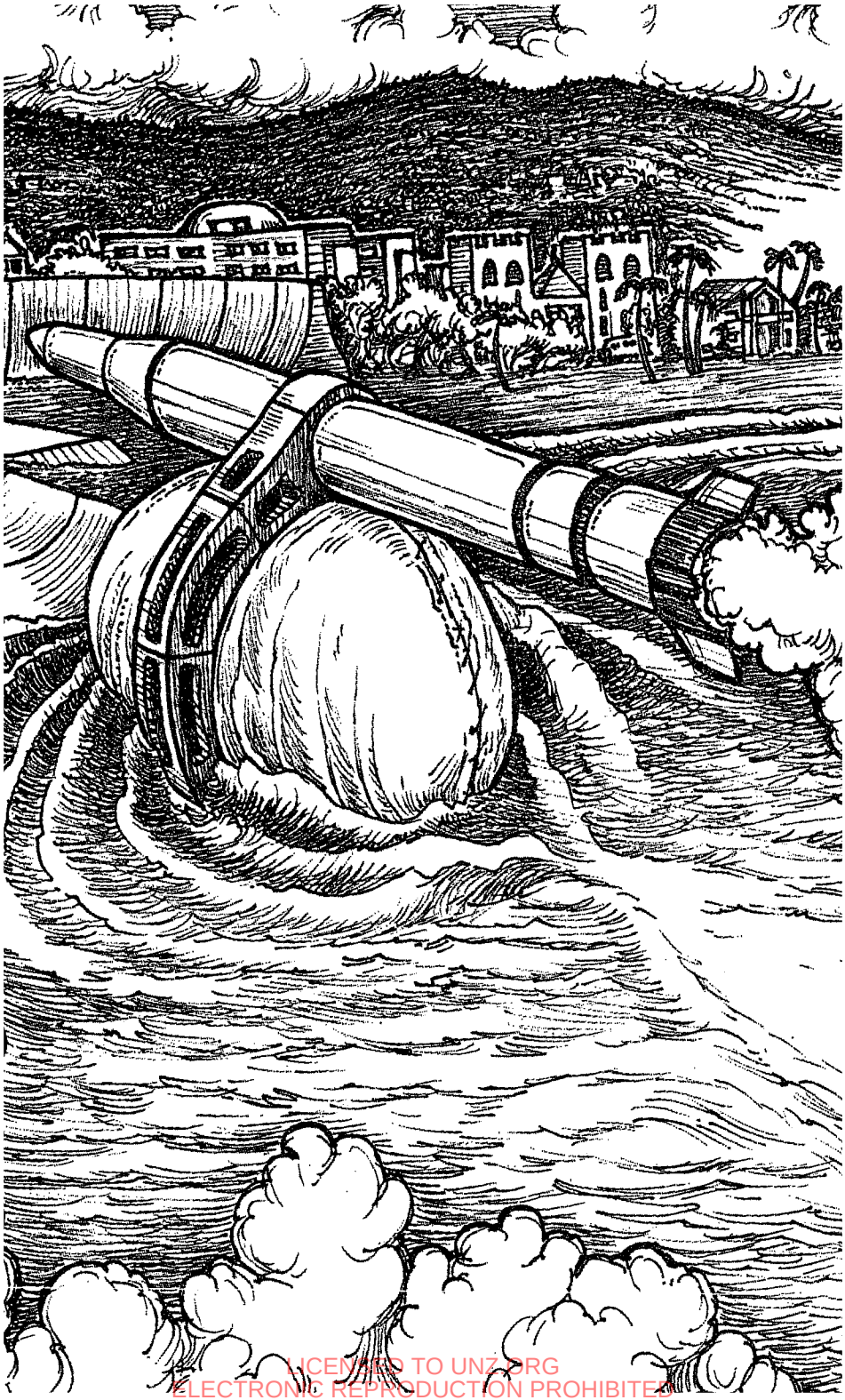

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CAMOUFLAGE

Part I of III

Joe Haldeman

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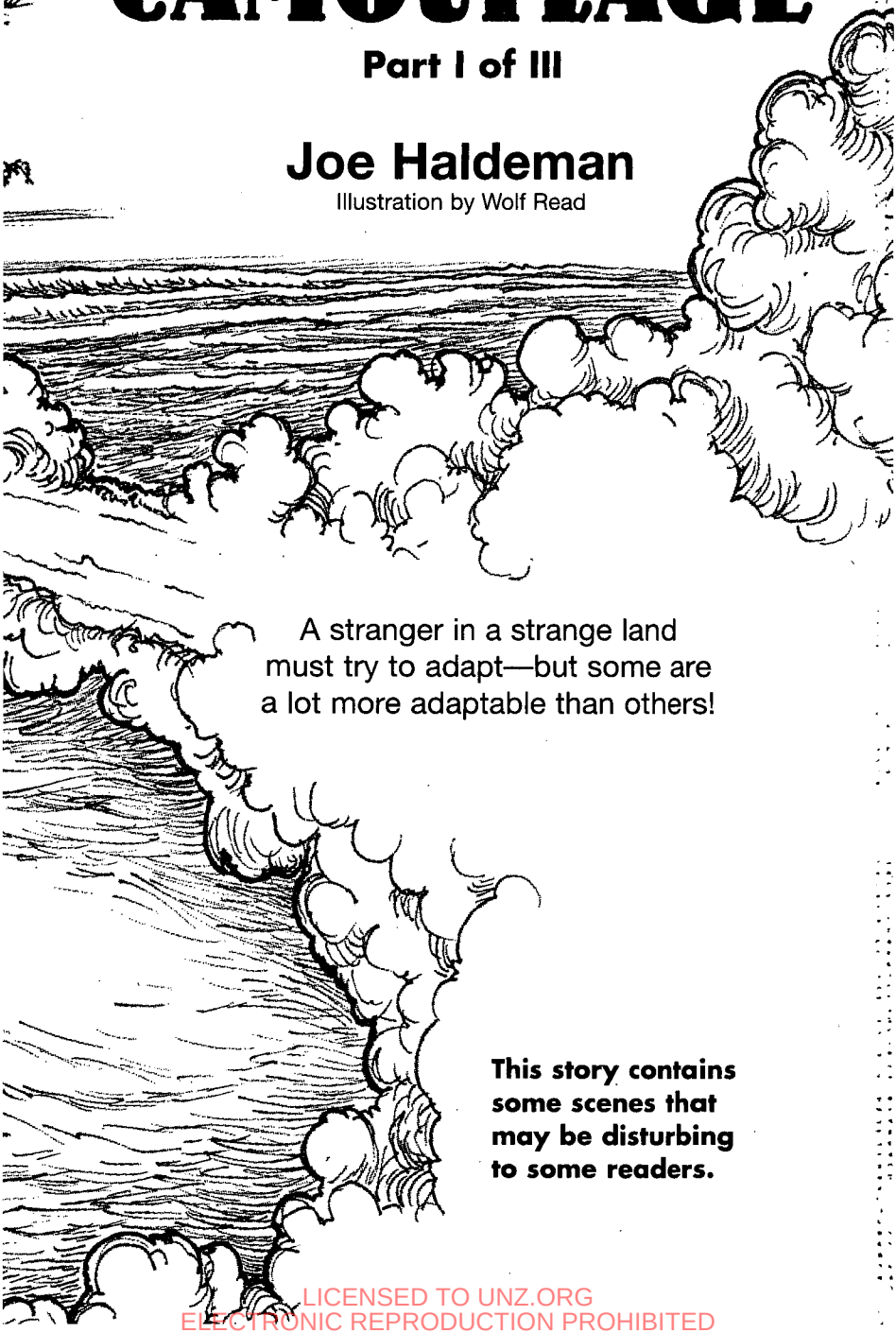

A stranger in a strange land must try to adapt—but some are a lot more adaptable than others!

This story contains some scenes that may be disturbing to some readers.

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1. Prologue

The monster came from a swarm of stars that humans call Messier 22, a globular cluster ten thousand light-years distant. A million stars with ten million planets—all but one of them devoid of significant life.

It's not a part of space where life could flourish. All of those planets are in unstable orbits, the stars swinging so close to one another that they steal planets, or pass them around, or eat them.

This makes for ferocious geological and climatic changes; most of the planets are sterile billiard balls or massive jovian gasbags. But on the one world where life has managed a toehold, that life is *tough*.

And adaptable. What kind of organisms can live on a world as hot as Mercury, which then is suddenly as distant from its sun as Pluto, within the course of a few years?

Most of that life survives by simplicity—lying dormant until the proper conditions return. The dominant form of life, though, thrives on change. It's a creature that can force its own evolution—not by natural selection, but by unnatural mutation, changing itself as conditions vary. It becomes whatever it needs to be—and after millions of swifter and swifter changes, it becomes something that can never die.

The price of eternal life had been a life with no meaning beyond simple existence. With its planet swinging wildly through the cluster, the creatures' days were spent crawling through deserts gnawing on rocks, scrabbling across ice, or diving into muck—in search of any food that couldn't get away.

The world spun this way and that, until random forces finally tossed it to the edge of the cluster, away from the constant glare of a million suns—into a stable orbit: a world that was only half day and half night; a world where clement seas welcomed diversity. Dozens of species became millions, and animals crawled up from the warm sea onto land grown green, buzzing with life.

The immortal creatures relaxed, life suddenly easy. They looked up at night, and saw stars.

They developed curiosity, then philosophy, and then science. During the day, they would squint into a sky with a thousand sparks of sun. In the night's dark, across an ocean of space, the cool billowing oval of our Milky Way Galaxy beckoned.

Some of them built vessels, and hurled themselves into the night. It would be a voyage of a million years, but they'd lived longer than that, and had patience.

Two hundred thousand years before the monster's man was born and its story began, one such vessel splashed into the Pacific Ocean. It went deep, following an instinct to hide. The creature that it carried to Earth emerged, assessed the situation, and became something appropriate for survival.

For a long time it lived on the dark bottom, under miles of water, large and invincible, studying its situation. Eventually, it abandoned its anaerobic hugeness, and took the form of a great white shark, the top of the food chain, and went exploring, while most of its essence stayed safe inside the vessel.

For a long time, it remembered where the vessel was, and remembered where it came from, and why. As centuries went by, though, it remembered less. After dozens of millenniums, it simply lived, and observed, and changed.

It encountered humanity and noted their acquired superiority—their placement, however temporary, at the top of every food chain. It became a killer whale, and then a porpoise, and then a swimmer, and waded ashore naked and ignorant.

But eager to learn.

2. Baja, California—2019

Russell Sutton had done his stint with the U.S. government around the turn of the century, a frustrating middle-

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management job in two Mars exploration programs. When the second one crashed, he had said goodbye to Uncle Sam and space in general, returning to his first love, marine biology.

He was still a manager and still an engineer, heading up the small firm Poseidon Projects. He had twelve employees, half of them Ph.Ds. They only worked on two or three projects at a time, esoteric engineering problems in marine resource management and exploration. They had a reputation for being wizards, and for keeping both promises and secrets. They could turn down most contracts—anything not sufficiently interesting; anything from the government.

So Russ was not excited when the door to his office eased open and the man who rapped his knuckles on the jamb was wearing an admiral's uniform. His first thought was that they really could afford a receptionist; his second was how to frame a refusal so that the guy would just leave, and not take up any more of his morning.

"Dr. Sutton, I'm Jack Halliburton."

That was interesting. "I read your book in graduate school. Didn't know you were in the military." The man's face was vaguely familiar from his memory of the picture on the back of *Bathyspheric Measurements and Computation*; no beard now, and a little less hair. He still looked like Don Quixote on a diet.

"Have a seat." Russ waved at the only chair not supporting stacks of paper and books. "But let me tell you right off that we don't do government work."

"I know that." He eased himself into the chair and set his hat on the floor. "That's one reason I'm here." He unzipped a blue portfolio and took out a sealed plastic folder. He turned it sideways and pressed his thumb to the corner; it read his print and popped open. He tossed it onto Russell's desk.

The first page had no title but TOP SECRET—FOR YOUR EYES ONLY, in red block letters.

"I can't open this. And as I said—"

"It's not really classified, not yet. No one in the government, outside of my small research group, even knows it exists."

"But you're here as a representative of the government, no? I assume you do own some clothes without stars on the shoulders."

"Protective coloration. I'll explain. Just look at it."

Russ hesitated, then opened the folder. The first page was a picture of a vague cigar shape looming out of a rectangle of gray smears.

"That's the discovery picture. We were doing a positron radar map of the Tonga-Kermadec Trench—"

"Why on Earth?"

"That part *is* classified. And irrelevant."

Russ had the feeling that his life was on a cusp, and he didn't like it. He spun around slowly in his chair, taking in the comfortable clutter, the pictures and the charts on the wall. The picture window looking down on the Sea of Cortez, currently calm.

With his back to Halliburton, he said, "I don't suppose this is something we could do from here."

"No. We've chosen a place in Samoa."

"Now, that's attractive. Heat and humidity and lousy food."

"I tend to think pretty girls and no winter." He pushed his glasses back on his nose. "Food's not bad if you don't mind American."

Russ turned back around and studied the picture. "You have to tell me something about why you were there. Did the Navy lose something?"

"Yes."

"Did it have people in it?"

"I can't answer that."

"You just did." He turned to the second page. It was a sharper view of the object. "This isn't from positrons."

"Well, it is. But it's a composite from various angles, noise removed."

Good job, he thought. "How far

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down is this thing?"

"The trench is seven miles deep there. The artifact is under another forty feet of sand."

"Earthquake?"

He nodded. "A quarter of a million years ago."

Russ stared at him for a long moment. "Didn't I read about this in an old Stephen King novel?"

"Look at the next page."

It was a regular color photograph. The object lay at the bottom of a deep hole. Russ thought about the size of that digging job; the expense of it. "The Navy doesn't know about this?"

"No. We did use their equipment, of course."

"You found the thing they lost?"

"We will next week." He stared out the window. "I'll have to trust you."

"I won't turn you in to the Navy."

He nodded slowly and chose his words. "The submarine that was lost is in the trench, too. Not thirty miles from this . . . object."

"You didn't report it. Because?"

"I've been in the Navy for almost twenty years. Twenty years next month. I was going to retire anyhow."

"Disillusioned?"

"I never was 'illusioned.' Twenty years ago, I wanted to leave academia, and the Navy made me an interesting offer. It has been a fascinating second career. But it hasn't led me to trust the military, or the government.

"Over the past decade I've assembled a crew of like-minded men and women. I was going to take some of them with me when I retired—to set up an outfit like yours, frankly."

Russ went to the coffee machine and refreshed his cup. He offered one to Halliburton, who declined.

"I think I see what you're getting at."

"Tell me."

"You want to retire with your group and set up shop. But if you suddenly 'discover' this thing, the government might notice the coincidence."

"That's a good approximation. Take a look at the next page."

It was a close-up of the thing. Its curved surface mirrored perfectly the probe that was taking its picture.

"We tried to get a sample of the metal for analysis. It broke every drill bit we tried on it."

"Diamond?"

"It's harder than diamond. And massive. We can't estimate its density, because we haven't been able to budge it, let alone lift it."

"Good God."

"If it were an atomic submarine, we could have hauled it up. It's not even a tenth that size.

"If it were made of lead, we could have raised it. If it were solid uranium. It's denser than that."

"I see," Russ said. "Because we raised the *Titanic*. . . ."

"May I be blunt?"

"Always."

"We could bring it up with some version of your flotation techniques. And keep all the profit, which may be considerable. But there would be hell to pay when the Navy connection was made."

"So what's your plan?"

"Simple." He took a chart out of his portfolio and rolled it out on Russ's desk. It snapped flat. "You're going to be doing a job in Samoa . . ."

3. San Jacinto, California—1931

Before it came out of the water, it formed clothes on the outside of its body. It had observed more sailors than fishermen, so that's what it chose. It waded out of the surf wearing white utilities, not dripping wet because they were not cloth. They had a sheen like the skin of a porpoise. Its internal organs were more porpoise than human.

It was sundown, almost dark. The beach was deserted except for one man, who came running up to the changeling.

"Holy cow, man. Where'd you swim from?"

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The changeling looked at him. The man was almost two heads taller than it, with prominent musculature, wearing a black bathing suit.

"Cat got your tongue, little guy?"

Mammals can be killed easily with a blow to the brain. The changeling grabbed his wrist and pulled him down and smashed his skull with one blow.

When the body stopped twitching, the changeling pinched open the thorax and studied the disposition of organs and muscles. It reconfigured itself to match, a slow and painful process. It needed to gain about 30 percent body mass, so it removed both arms, after studying them, and held them to its body until they were absorbed. It added a few handfuls of cooling entrails.

It pulled down the bathing suit and duplicated the reproductive structure that it concealed, and then stepped into the suit. Then it carried the gutted body out to deep water and abandoned it to the fishes.

It walked down the beach toward the lights of San Jacinto, a strapping handsome young man, duplicated down to the fingerprints, a process that had taken no thought, but an hour and a half of agony.

But it couldn't speak any human language and its bathing suit was on backwards. It walked with a rolling sailor's gait; except for the one it had just killed, every man it had seen for the past century had been walking on board a ship or boat.

It walked toward light. Before it reached the small resort town, the sky was completely dark, moonless and spangled with stars. Something made it stop and look at them for a long time.

The town was festive with Christmas decorations. It noticed that other people were almost completely covered in clothing. It could form more clothing on its skin, or kill another one, if it could find one the right size alone. But it didn't have a chance.

Five teenagers came out of a burger joint with a bag of hamburgers. They were laughing, but suddenly stopped dead.

"Jimmy?" a pretty girl said. "What are you doing?"

"Ain't it a little cool for that?" a boy said. "Jim?"

They began to approach it. It stayed calm, knowing it could easily kill all of them. But there was no need. They kept making noises.

"Something's wrong," an older one said. "Did you have an accident, Jim?"

"He drove out with his surfing board after lunch," the pretty girl said, and looked down the road. "I don't see his car."

It didn't remember what language was, but it knew how whales communicated. It tried to repeat the sound they had been making. "Zhim."

"Oh my God," the girl said. "Maybe he hit his head." She approached it and reached toward its face. It swatted her arms away.

"Ow! My God, Jim." She felt her forearm where it had almost fractured it.

"Mike odd," it said, trying to duplicate her facial expression.

One of the boys pulled the girl back. "Somethin' crazy's goin' on. Watch out for him."

"Officer!" the older girl shouted. "Officer Sherman!"

A big man in a blue uniform hustled across the street. "Jim Berry? What the hell?"

"He hit me," the pretty one said. "He's acting crazy."

"My God, Jim," it said, duplicating her intonation.

"Where your clothes, buddy?" Sherman said, unbuttoning his holster.

It realized that it was in a complex and dangerous situation. It knew these were social creatures, and they were obviously communicating. Best try to learn how.

"Where your clothes, buddy," it said in a deep bass growl.

"He might have hit his head surfing,"

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the girl who was cradling her arm said. "You know he's not a mean guy."

"I don't know whether to take him home or to the hospital," the officer said.

"The hospital," it said.

"Probably a good idea," he said.

"Good idea," it said. When the officer touched its elbow it didn't kill him.

4. Mid-Pacific—2019

It worked like this: Poseidon Projects landed a contract from a Sea World affiliate—actually a dummy corporation that Jack Halliburton had built out of money and imagination—to raise up an Spanish-American War era relic, a sunken destroyer, from Samoa. But no sooner had they gotten their equipment in place than they got an urgent summons from the U.S. Navy—there was a nuclear submarine down in the Tonga trench, and they couldn't lift it as fast as Poseidon. There might be men still alive in it. They covered the 500 miles as fast as they could.

Of course Jack Halliburton knew that the sub had ruptured and there was no chance of survivors. But it made it possible for Russell Sutton to ply down the length of the Tonga-Kermadec Trench. He made routine soundings as he went, and discovered a mysterious wreck not far from the sub.

There was plenty of respectful news coverage of the two crews' efforts—Sutton's working out of professional courtesy and patriotism. Raising the *Titanic* had given them visibility and credibility. With all the derring-do and pathos and technological fascination of the submarine story, it was barely a footnote that Russ's team had seen something interesting on the way, and had claimed salvage rights.

It was an impressive sight when the sub came surging out of the depths, buoyed up by the house-sized orange balloons that Russ had brought to the task. The cameras shut down for the grisly business of removing and identifying the sailors' remains. They all came on again for the 121 flag-draped caskets on the deck of the carrier that wallowed in the sea next to the floating hulk of the sub.

Then the news people went home, and the actual story began.

5. San Jacinto—1931

They put a white hospital robe on it and sat it down in an examination room. It continued the safe course of imitative behavior with the doctors and nurses and with the man and woman who were the real Jimmy's father and mother, even duplicating the mother's tears.

The father and mother followed the family doctor to a room out of earshot.

"I don't know what to tell you," Dr. Farben said. "There's no evidence of any injury. He looks to be in excellent health."

"A stroke or a seizure?" the father asked.

"Maybe. Most likely. We'll keep him under observation for a few days. It might clear up. If not, you'll have to make some decisions."

"I don't want to send him to an institution," the mother said. "We can take care of this."

"Let's wait until we know more," the doctor said, patting her hand but looking at the father. "A specialist will look at him tomorrow."

They put it in a ward, where it was observant of the other patients' behavior, even to the extent of using a urinal correctly. The chemistry of the fluid it produced might have puzzled a scientist. The nurse remarked on the fishy odor, not knowing that some of it was left over from a porpoise's bladder.

It spent the night in some pain as its internal organs sorted themselves out. It kept the same external appearance. It reviewed in its mind everything it had observed about human behavior, knowing that it would be some time before it could convincingly interact.

It also reflected back about itself. It

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was no more a human than it had been a porpoise, a killer whale, or a great white shark. Although its memory faded over millennia past vagueness into darkness, it had a feeling that most of it was waiting, back there in the sea. Maybe it could go back, as a human, and find the rest of itself.

A couple enjoying the salt air at dawn found a body the tide had left in a rocky pool. It had been clothed only in feasting crabs. There was nothing left of the face or any soft parts, but by its stature, the coroner could tell it had been male. A shark or something had taken both its arms, and all its viscera had been eaten away.

No locals or tourists were missing. A reporter suggested a mob murder, the arms chopped off to get rid of fingerprints. The coroner led him back to show him the remains, to explain why he thought the arms had been pulled off—twisted away—rather than chopped or sawed, but the reporter bolted halfway through the demonstration.

The coroner's report noted that from the state of decomposition of the remaining flesh, he felt the body had been immersed for no more than twelve hours. Sacramento said there were no appropriate missing persons reports. Just another out-of-work drifter. The countryside was full of them, these days, and sometimes they went for a swim with no intention of returning to shore.

Over the next two days, three brain specialists examined Jimmy, and they were perplexed and frustrated. His symptoms resembled a stroke in some ways; in others, profound amnesia from head trauma, for which there was no physical evidence. There might be a tumor involved, but the parents wouldn't give permission for X-rays. This was fortunate for the changeling, because the thing in its skull was as much a porpoise brain as it was a human's, and various parts of it were nonhuman crystal and metal.

A psychiatrist spent a couple of hours with Jimmy, and got very little that was useful. His response to the word association test was interesting: he parroted back each word, mocking the doctor's German accent. In later years the doctor might classify the behavior as passive-aggressive, but what he told the parents was that at some level the boy probably had all or most of his faculties, but he had regressed to an infantile state. He suggested that the boy be sent to an asylum, where modern treatment would be available.

The mother insisted on taking him home, but first allowed the doctor to try fever therapy, injecting Jimmy with blood from a tertian malaria patient. Jimmy sat smiling for several days, his temperature unchanging—the body of the changeling consuming the malarial parasites along with other hospital food—and he was finally released to them after a week of fruitless observation.

They had retained both a male and a female nurse; their home overlooking the sea had plenty of room for both employees to stay in residence.

Both of them had worked with retarded children and adults, but within a few days they could see that Jimmy was something totally unrelated to that frustrating experience. He was completely passive but never acted bored. In fact, he seemed to be studying them with intensity.

(The female, Deborah, was used to being studied with intensity: she was pretty and voluptuous. Jimmy's intensity puzzled her because it didn't seem to be at all sexual, and a boy his age and condition ought to be brimming with sexual energy and curiosity. But her "accidental" exposures and touches provoked no response at all. He never had an erection, never tried to look down her blouse, never left any evidence of having masturbated. At this stage in its de-

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velopment, the changeling could only mimic behavior it had seen.)

It was learning how to read. Deborah spent an hour after dinner reading to Jimmy from children's books, tracing the words with her finger. Then she would give Jimmy the book, and he would repeat it, word for word—but in *her* voice.

She had the male nurse, Lowell, read to him, and then of course he would mimic Lowell. That made the feat less impressive, as reading. But his memory was astonishing. If Deborah held up any book he had read and pointed to it, he could recite the whole thing.

Jimmy's mother was encouraged by his progress, but his father wasn't sure, and when Dr. Grossbaum made his weekly visit, he sided with the father. Jimmy parroted the list of facial nerves that every medical student memorizes, and then a poem by Schiller, in faultless German.

"Unless he's secretly studied German and medicine," Grossbaum said, "he's not remembering anything from before." He told them about idiots savants, who had astonishing mental powers in some narrow specialty, but otherwise couldn't function normally. But he'd never heard of anyone changing from a normal person into an idiot savant; he promised to look into it.

Jimmy's progress in less intellectual realms was fast. He no longer was clumsy walking around the house and grounds—at first he hadn't seemed to know what doors and windows were. Lowell and Deborah taught him badminton, and after initial confusion he had a natural talent for it—not surprising, since he'd been the best tennis player in his class. They were amazed at what he could do in the swimming pool—when he first jumped in, he did two rapid lengths underwater, using a stroke neither of them could identify. When they demonstrated the Australian crawl, breast stroke, and backstroke, he "remembered" them immediately.

By the second week, he was taking his meals with the family, not only manipulating the complex dinner service flawlessly, but also communicating his desires clearly to the servants, even though he couldn't carry on a simple conversation.

His mother invited Dr. Grossbaum to dinner, so he could see how well Jimmy was getting along with the help. The psychiatrist was impressed, but not because he saw it as evidence of growth. It was like the facial nerves and German poetry; like badminton and swimming. He could imitate anybody perfectly. When he was thirsty, he pointed at his glass, and it was filled. That's what his mother did, too.

His parents had evidently not noticed that every time a servant made a noise at Jimmy, he nodded and smiled. When the servant's action was completed, he nodded and smiled again. That did get him a lot of food, but he was a growing boy.

Interesting that the nurses' records showed no change in weight. Exercise?

It was unscientific, but Grossbaum admitted to himself that he didn't like this boy, and for some reason was afraid of him. Maybe it was his psychiatric residency in the penal system—maybe he was projecting from that unsettling time. But he always felt that Jimmy was studying him intently, the way the intelligent prisoners had: *what can I get out of this man?*

A better psychiatrist might have noticed that the changeling treated everyone that way.

6. Apia, Independent Samoa—2019

It takes a long time for cement to cure in the tropics, and the artifact stayed floating offshore, shrouded, for two weeks while the thick slab, laced with rebar, slowly hardened. They knew that no conventional factory floor could support the massive thing without collapsing. It was the size of a small truck, but somehow weighed more than a subma-

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rine: 5,000 metric tonnes. It would be three times as dense as plutonium, if it were a solid chunk of metal.

Halliburton had started to let his beard and hair grow out the day he retired his commission. The beard was irregular and wispy, startling white against his sun-darkened skin. He had taken to wearing gaudy Hawaiian shirts with a white linen tropical suit. He would have looked more dapper if he didn't smoke a pipe, which accented his white clothes with gray smudges of spilled ash.

Russell regarded his partner with a mixture of affection and caution. They were waiting for lunch, sipping coffee on a veranda that overlooked the Harbour Light beach.

The morning was beautiful, like most spring mornings here. Tourists sunned and strutted on the dark sand beach, children laughed and played, couples with no particular skill churned rented dugouts in the shallows over the reef, probably annoying divers.

Russell picked up a small pair of binoculars and studied a few of the women on the beach. Then he scanned the horizon line to the north, and could just make out a pair of fluttering pennants that marked their floating treasure. "Did you get through to Manolo this morning?"

Halliburton nodded. "He was headed for the site. Says they're going to test the rollers today."

"What on Earth with?"

"A couple of U.S. Marine Corps tanks. They went missing from the Pago Pago armory, along with a couple of crews. You want to know how much they cost?"

"That's your department."

"*Nada*. Not a damn thing." He chuckled. "It's a mobilization exercise."

"Convenient. That colonel we had dinner with, the Marine."

"Of course." Three waiters brought their meal, two piles of freshly sliced fruit and a hot iron pan of sizzling sausages. Halliburton sent away his coffee and asked for a Bloody Mary.

"Celebrating?"

"Always." He ignored the fruit and tore into the sausages. "The test should commence about 1400."

"How much do tanks weigh?" Russell served himself mango, pawpaw, and melon.

"I'd have to look it up. About sixty tons."

"Oh, good. That's within a couple of orders of magnitude."

"Have to extrapolate."

"Let's see." He sliced the melon precisely. "If a two-pound chicken can sit on an egg without harming it, let's extrapolate the effect of a one-ton chicken."

"Ha ha." The waiter brought the Bloody Mary and whispered, "With gin, sir." Halliburton nodded microscopically.

"It's not exactly Hooke's Law," Russell continued. "How can you get a number that means anything?"

Halliburton set down his silverware and wiped his fingers carefully, and took a pad out of his shirt pocket. He tapped on its face a few times. "The Wallace-Gellman Algorithm."

"Never heard of it."

He adjusted the brightness of the pad and passed it over. "It's about compressibility. The retaining plates we drove down into the sand. It's actually the column of sand supporting the thing's mass, of course."

"A house built on sand. I read about that." Russell studied the pad and tapped on a couple of variables for clarification. He grunted assent and passed it back. "Where'd you get it?"

"Best Buy."

He winced. "The algorithm."

"California building code. A house built on sand shall not stand without it."

"Hm. So how much does an apartment building weigh?"

"We're in the ballpark. It's going to settle some. That's why the moat-and-

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dike design."

"If it settles more than five meters, we won't have a moat. We'll have an underwater laboratory." Once the thing was in place, the plan was to put a pre-fabricated dome, five meters high, over the thing, dig a moat around it, and then a high dike around the moat. (If it settled more than a couple of feet, water would seep around it at high tide anyhow. The moat made that inevitability a design feature.)

"Won't happen. It was in sand when we found it, remember?"

Not volcanic sand, Russell thought, but he didn't want to argue it. The coral sand wasn't that much more compressible, he supposed. He signaled the waiter. "Is it after noon, Josh?"

"Always, sir. White wine?"

"Please." He reached over the fruit and speared a sausage.

"So when do we expect the tanks?"

"They said 1300."

"Samoan time?"

"U.S. Marine Corps time. They have to get them back by nightfall, so I expect they'll be prompt."

The Marines were a little early, in fact. At 12:45, they could hear the strained throbbing of the cargo helicopters working their way around the island. They probably didn't want to fly directly over it. Don't annoy an armed populace.

It was two antique CH-53 cargo helicopters, each throbbing rhythmically under the strain of its load, a sand-colored Powell tank that swung underneath with the ponderous grace of a sixty-ton pendulum. They circled out over the reef before descending to the Poseidon site, a forty-acre rhombus of sand and scrub inside a tall hurricane fence.

Two men on the ground guided them in, the tanks settling in the sand with one solid crunch. The helicopters hummed easily as they reeled in their cables and touched down delicately on the perforated-steel plate landing pad just above the high-tide line.

There were three Poseidon engineers waiting at the site. Greg Fulvia, himself just a few years out of the Marines, went to talk with the tank crews, while Naomi Linwood and Larry Pembroke did a final collimation of the four pairs of laser theodolites that would measure the deformation of the concrete floor while the great machines crawled back and forth on it.

A couple of workers rolled up in a beach buggy and set up a canopy over a folding table where Russell and Halliburton were waiting under the Sun. They put out four chairs and a cooler full of bottled water and limes on ice. Naomi came over to take advantage of it, yelling "Bring you one" to Larry over her shoulder.

Naomi was brown from the Sun and as big as Russell, athletic, biceps tight against the cuffed sleeves of her khaki work clothes, dark sweat patches already forming. She had severe Arabic features and a bright smile.

She squeezed half a lime into a glass and bubbled ice water over it, carbonation sizzling, and drank half of it in a couple of gulps. She wiped her mouth with a blue bandana and then pressed it to her forehead. "Pray for rain," she said.

"Are you serious?" Halliburton said.

She grimaced. "My prayers are never answered." She looked at the cumulus piling up over the island. "Good if we could get most of this done by 2:30." It usually rained around three. "Comes down hard, we may get sand in the mountings."

"Would that throw off the readings?"

She pulled her sunglasses down on her nose and looked over them at him. "No; they're locked in now. I'd just rather watch TV tonight than take down the tripods and clean them." One of the tanks roared and coughed white smoke. "All *right*." She set the glass down and jogged toward Larry with the rest of the bottle.

Russell and Halliburton didn't have to be there; the measuring was straightfor-

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ward. But there wasn't anything else to do until the artifact was brought in the next day. Halliburton called the central computer with his note pad and gave it the Wallace-Gellman numbers, which were basically the number of millimeters the concrete pad flexed in three directions as the tanks wheeled from place to place. The artifact would eventually rest in the center of the slab, which was a little smaller than a basketball court, but it would have to be rolled or dragged there from the edge. They wanted to be sure the thing wouldn't flex the slab so much that it broke in the process.

Trouble came in the form of a young man who was not dressed for the beach; not dressed for Samoa heat. He belonged in an air conditioned office, with his dark rumpled jacket and tie. He walked up to the yellow tape border—DANGER DO NOT PASS—and waved toward Halliburton and Russell, calling out, "I say! Hello?" A very black man with a British accent.

Russell left Halliburton with his numbers and approached the man cautiously. They didn't see many strangers, and never without a rent-a-cop escort.

"How did you get by the guard?" Russ said.

"Guard?" His eyebrows went up. "I saw that little house, but there was no one in it."

"Or just possibly you waited for the guard to take a toilet break, and snuck in. We really should hire two. You did see the sign."

"Yes, private property; that piqued my interest. I thought this was free beach here."

"Not now."

"But the gate of the fence there was open. . . ."

The guard came running up behind the man. "I'm sorry, Mr. Sutton. He got by—"

Russ waved it off. "We have a lease on this stretch," he told the black man.

"Poseidon Projects," he said, nodding. That wasn't on the sign.

"So you know more about me than I know about you. Work for the government?"

He smiled. "American government. I'm a reporter for the *Pacific Stars and Stripes*."

An army newsie. "You're in the military?" He didn't look it.

He nodded. "Sergeant Tulip Carson, sir." To Russ's quizzical look, he added, "In the middle of gender reassignment, sir."

It was a lot to absorb all at once, but Russ managed a reply. "We aren't speaking to the press at this time."

"You volunteered for the submarine rescue last year," he said quickly, "and then claimed salvage on a sunken vessel you'd detected on the way."

"Public record," Russ said. "Good-bye, Sergeant Carson." He turned and walked away.

"But there's no record of a ship ever going down there. Mr. Sutton? And now you have that shrouded float waiting out there . . . and the helicopters and tanks . . ."

"Good day, Sergeant," he said to the air, smiling. This is the way they'd wanted the publicity to start. Something mysterious? Who, us?

By the time they unveiled the artifact, the whole world would be watching.

7. San Jacinto—1932

The changeling began to construct sentences on its own just before Christmas, but nothing complex, and often it was nonsense or weirdly encoded. It still "wasn't quite right," as Jimmy's mother nervously said. The changeling didn't have to acquire intelligence, which it had in abundance, but it had to understand intelligence in a human way. That was a long stretch from any of the aquatic creatures it had successfully mimicked.

It came from a race with a high degree of social organization, but had forgotten all of that millennia ago. On

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Earth, it had lived as a colony of individual creatures in the dark hot depths; it had lived as a simple mat of protoplasm before that. It had lived in schools of fish, briefly, but most of its recent experience, tens of thousands of years, had been as a lone predator.

It had seen that predation was modified in these creatures; they were at the top of the food chain, but animal food had long since been killed by the time they consumed it. It naturally tried to understand the way society was organized in those terms: food was killed in some hidden or distant location, and prepared and distributed by means of mysterious processes.

The family unit was organized around food presentation and consumption, though it had other functions. The changeling recognized protection and training of the young from its aquatic associations, but was ignorant about sex and mating—when another large predator approached, it had always interpreted that as aggression, and attacked. Its kind hadn't reproduced in millions of years; that anachronism had gone the way of death. It didn't know the facts of life.

At least one woman was more than willing to provide lessons.

When it knew it would be alone for a period, the changeling practiced changing its appearance, using the people it observed as models. Changing its facial features was not too difficult; cartilage and subcutaneous fat could be moved around in a few minutes, a relatively painless process. Changing the underlying skull was a painful business that took eight or ten minutes.

Changing the whole body shape took an hour of painful concentration, and was complicated if the body had significantly more or less mass than Jimmy. For less mass, it could remove an arm or a leg, and redistribute mass accordingly. The extra part would die, but that was immaterial; it still provided the right raw materials to reconstruct Jimmy.

Making a larger body required taking on flesh; not easy to do. The changeling assimilated Ronnie, the family's old German Shepherd, in order to take the form of Jimmy's overweight father. Of course Ronnie was dead when he was reconstituted; the changeling left the body outside Jimmy's door, and the family just assumed it had gone there to say goodbye, how sweet.

The changeling had seen Mr. Berry in a bathing suit, so about 90 percent of its simulation was accurate. The other ten percent might have made Mrs. Berry faint.

Similarly, the changeling could, in the dark privacy of Jimmy's bedroom, discard an arm and most of a leg and make itself a piece of flesh that had a shape similar to that of the nurse Deborah, at least the form she apparently had under her uniform, severely corseted. But it had no more detail than a department store dummy. The times being what they were, it could have had free rein of the house and not found any representation of a nude female.

It was still months away from being able to simulate anything like social graces, but to satisfy this particular desire, no grace was needed. Precisely at 7:30, Deborah brought in the breakfast tray.

"Please take off your clothes," it said, "and put them on the dresser."

Deborah may or may not have recognized the doctor's voice. She managed not to drop the tray. "Jimmy! Don't be silly!"

"Please," Jimmy said, smiling, as she positioned the lap tray. "I would like that very much."

"So would I," she whispered, and glanced back to see that the door was almost shut. "How about tonight? After dark?"

"I can see in the dark," it said in her whisper, husky. She slid her hand into his pajamas, and when she touched the penis an unused circuit closed, and it enlarged and rose with literally inhuman

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speed.

"Oh my God," she said. "Midnight?"

"Midnight," it repeated. "Oh my God."

Her smile was a cross between open-mouthed astonishment and a leer. "You're strange, Jimmy." She backed out of the room, mouthing "midnight," and closed the door quietly.

The changeling noted this new erect state and experimented with it, and the unexpected result suddenly clarified a whole class of mammalian behavior it had witnessed with porpoise, dolphin, and killer whale.

The music teacher came for his twice-weekly visit, and was stupefied by the sudden change in Jimmy's ability. The boy had been a mystery from the start: before the accident, he had taken piano lessons from age ten to thirteen, but had quit out of frustration, boredom, and puberty. Or so they thought. He must have been practicing secretly.

The new teacher, Jefferson Sheffield, had been hired on Dr. Grossbaum's recommendation. His specialty was music for therapy, and under his patient tutelage many mentally ill and retarded people had found a measure of peace and grace.

Jimmy's performance on the piano had been like his idiot-savant talent with language: he could repeat anything Sheffield did, note for note. Left to his own devices, he would either not play or reproduce one of Sheffield's lessons with perfect fidelity.

This morning it improvised. It sat down and started playing with what appeared to be feeling, making up things that used the lessons as raw material, but transposed and inverted them, and linked them with interesting cadenzas and inventive chord changes.

He played for exactly one hour and stopped, for the first time looking up from the keyboard. Sheffield and most of the family and staff were sitting or standing around, amazed.

"I had to understand something," it said to no one in particular. But then it gave Deborah a look that made her tremble.

Dr. Grossbaum joined Sheffield and the family for lunch. The changeling realized it had done something seriously wrong, and retreated into itself.

"You've done something wonderful, son," Sheffield said. It looked at him and nodded, usually a safe course of action. "What caused the breakthrough?" It nodded again, and shrugged, in response to the interrogative tone.

"You said that you had to understand something," he said.

"Yes," it said, and into the silence: "I had to understand something." It shook its head, as if to clear it. "I had to *learn* something."

"That's progress," Grossbaum said. "Verb substitution."

"I had to find something," it said. "I had to be something. I had to be some . . . one."

"Playing music let you be someone different?" Grossbaum said.

"Someone different," it repeated, studying the air over Grossbaum's head. "Make . . . made. Made me someone different."

"Music made you someone different," Sheffield said with excitement.

It considered this. It understood the semantic structure of the statement, and knew that it was wrong. It knew that what made it different was new knowledge about that unnamed part of its body, how it would stiffen and leak something new. But it knew that humans acted mysteriously about that part, and so decided not to demonstrate its new knowledge, even though the part was stiff again.

It saw that Grossbaum was looking at that part, and reduced blood flow, to make it less prominent. But he had noticed; his eyebrow went up a fraction of an inch. "It's not all music," he said, "is it?"

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"It's all music," the changeling said.

"I don't understand."

"You don't understand," the changeling looked at its hands. "It's all music."

"*Life* is all music," Sheffield said. The changeling looked at him and nodded. Then it rose and crossed the room to the piano, and started playing, which seemed safer than talking.

It was awake at midnight, when the door eased open. Deborah closed it silently behind her and padded on bare feet to the bed. She was wearing oversized men's pajamas.

"You have clothes," it said.

"I just got up to get a glass of milk," she said, confusing it. The fluid it produced that way was not milk, and to fill a glass would take all night.

She read its expression almost correctly and smiled. "In case I get caught, silly."

A little moonlight filtered through the curtains. The changeling adjusted its irises and made it bright as day, watching her slowly unbutton the pajama top.

It noted the actual size and disposition of breasts, not the way they appeared when she was clothed. The pigmentation and placement of nipples and aureoles. (It had wondered about its own nipples, which seemed to have no function.)

She slipped into bed next to it, and it attempted to pull down the pajama bottoms.

"Naughty, naughty." She kissed it on the mouth and moved one of its hands to a breast.

The kiss was odd, but it was something it had seen, and returned with a little force.

"Oh my," she whispered. "Aren't you the cat's pajamas."

That was pretty confusing. "No, I'm not."

"Just a saying." It moved both hands over her body, studying, measuring. Most of it was similar to the male body it copied, but the differences were interesting.

"Oh," she said. "More." It wondered whether it was an appropriate time to leak fluid itself, and began to.

"Oh no," she said; "oh my." She shucked off her pajama bottoms and slid up his body to clasp him, and move up and down.

It was an extraordinary sensation, similar to what he had done alone earlier, but much more intense. It allowed the body's reflexes to take over, and they pounded together perhaps a dozen times, and then its body totally concentrated on that part, galvanized, and explosively excreted—three, four, five times, the pressure decreasing.

It breathed hard into the space between her breasts. She slid down to join her mouth with its. She inserted her tongue, which was probably not an offering of food. It reciprocated.

She rolled over onto her back, breathing hard. "Glad you remember something."

8. Apia, Samoa—2019

They had a lot of company when two tugs began to tow the artifact toward the beach. Three military helicopters jockeyed for space with six from news organizations.

It was a perplexing sight. The artifact wasn't visible even from directly overhead, though the shroud over it had been removed. The titanium-mesh net that carried its mass kept it suspended a meter above the ocean floor, and the water was perfectly transparent.

A newsie photographer with diving gear jumped from a helicopter skid and went down beside it, and saw a sand-colored drape over a long cigar-shaped object. The drape fluttered once and revealed a shiny mirror surface. The mesh of the net was too fine for the newsie to reach through and expose it, but it was moving slowly enough for her to swim alongside and offer pictures and a running commentary, amusing for its lack

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of content, as the artifact hit the sandy floor and crunched through dead coral on its way to shore. It made a groove a meter deep in the sand, and the cables pulling it yanked tight and thrummed with the force of moving it.

When the tugs came gently aground, Greg and Naomi dragged a heavy cable through the light surf and dove with it, giving the newsie something to photograph. They cut through the mesh with a torch and pulled back the drape while the other two engineers worked their way down the cable with a large metal collar.

The collar, a meter round, supported four thick bolts. They slipped it over the shiny metal thing, and drove the bolts down with an air hammer, deafening in the water. When they were done, they took out earplugs and waved at the dazed newsie, and swam back along the cable.

A deeply anchored winch on the far side of the concrete slab growled into life, and the cable started to crawl out of the sea. When the cable sang taut, the growl increased in pitch and volume. People around the large machine could smell ozone and hot metal as it strained. But it won; the cable inched its way up the pad.

The artifact wormed slowly up through the surf. You wouldn't have to know anything about physics or engineering to see that there was something fundamentally strange going on—the thing's unearthly heaviness as it sledged through the damp sand; its mirror brightness.

The barrier of bright yellow DO NOT CROSS ribbon may have saved some lives. The cable started to fray where it was attached to the collar, then suddenly snapped, and a hundred meters of thick heavy cable whipped back with terrible speed. The broken end of it smashed through the window that protected the winch operator, Larry Pembroke, and sheared off his arm at the shoulder.

One of the Marine helicopters was down in less than a minute, and while the corpsman gave first aid they put the severed limb in a cooler full of beer and Cokes. They were in the air in another minute, streaking toward Pago Pago, where a surgical team was assembling. He'd be all right in a few months, though it would cost Poseidon, as the saying goes, an arm and a leg.

By the time the excitement had settled down, Russ and Jack had considered and discarded three plans for getting the heavy thing up on its slab. It lay there in the surf half-beached, weighing more than ten whales.

Since it seemed indestructible, Jack was in favor of using explosives—a large enough shaped charge would pitch it forward. Russ was totally against the idea, since there was no way of telling how delicate the artifact was inside. Nonsense, Jack said; the thing had gone through earthquakes under crushing pressure. If there was anything fragile inside, it was long since garbaged.

They asked Naomi, who had been a demolition engineer, and she said that intuitively it seemed impractical, and then did some numbers. No way. A free-standing shaped charge doesn't direct all its force in one direction. The side blast would make a crater so big it would swallow the concrete slab—and the explosion would probably shatter every window on this side of the island.

But she suggested a kind of explosive that is truly linear: a rocket engine. If they could strap a booster from a small space shuttle onto it—if it were a kind they could shut off!—they could drag it up onto the slab by brute force.

And think of the visuals.

They got the other engineers together and hashed out the details. They'd need a kind of chute, to keep it going in a straight line, and the booster would have to be a kind that could be carefully controlled. The thing was pointed straight at Maggie Grey's Hotel, and it would be bad publicity to demolish a

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century-old landmark full of tourists, where Jack had finally taught the bartender how to make a decent martini.

But the scheme would be great publicity if it worked. They called the American, French, and British space agencies, but China underbid everyone by half: a mere billion eurobucks. Jack called some people and found he could underwrite a quarter of it by granting an exclusive news franchise. By lunchtime they were joined by a Chinese lawyer with a short contract and a big notebook of specifications.

They could have their rocket in eight days. Jack grumbled about that—they'd be old news by then—but it's not exactly like buying a car off the lot. And the artifact wasn't going anywhere.

9. San Jacinto—1932

"Jimmy" had made a little too much noise during its sexual initiation, and although Mr. Berry was secretly relieved that his boy was doing *something* normal, he obeyed his wife's wishes and fired Deborah, slipping her a $100 bill as she left. That was a year's rent for her; more than adequate compensation.

The changeling was becoming human enough to be slightly annoyed to find her replaced by another male, but it had learned enough from the one encounter that its simulation of a woman would fool anyone but a thorough gynecologist.

Dr. Grossman wondered whether Jimmy's astounding musical performance extended into related areas of motor control, and so for the next meeting he brought along a friend who was an artist—and also a beautiful woman. He wanted to observe the boy's reaction to that, as well as his skill with a pencil.

Jimmy did show some special interest when they were introduced. She was a stunning blonde who matched his own six feet.

"Jimmy, this is Irma Leutij. Everyone calls her Dutch."

"Dutch," it repeated.

"Hello, Jimmy," she said in the husky voice she automatically used with attractive men. She calculated that Jimmy was about five years her junior, wrong by millennia.

"We want to do an experiment with drawing," Grossbaum said. "Dutch is an artist."

The changeling knew the sense of the word "experiment," and was cautious. "Artist . . . experiment?"

"Do you like to draw?" Dutch said. It shrugged in a neutral way.

Grossbaum snapped open his briefcase and took out two identical drawing tablets and plain pencils. He gestured toward the breakfast-room table. "Let's sit over there." Jimmy followed them and sat down next to Dutch. The psychiatrist put open tablets and pencils in front of them and sat down opposite.

"What shall I draw?" Dutch said. "Something simple?"

"Simple but precise. Maybe a cube in perspective."

She nodded and did it, nine careful lines in four seconds.

"Jimmy?" He pushed a pencil toward the boy.

The changeling was cautious, remembering people's reaction to the piano playing. It could have duplicated the woman's actions exactly, but instead slowed down to a crawl.

Grossbaum noted the speed. He also noted that Jimmy's cube was a precise copy, even to its position on the page and accidental overlap of two lines, less than a millimeter. An expert artist could have done it if you asked for an exact copy. The slow compulsive precision would be appropriate for an idiot savant.

But as far as he could find, reading and talking to people, you had to be born with that condition—nobody had ever become an idiot savant from a blow on the head or a stroke.

"Let me draw him," Dutch said, "and see whether he draws me."

"It's an idea," he said doubtfully. The

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boy would probably just copy his own portrait, precisely.

Dutch turned the page back and picked up her pencil and stared at Jimmy.

It returned her stare, unblinking. She smiled and it smiled. When she began to draw, though, it didn't do anything but watch.

She finished the simple portrait in a couple of minutes, and turned the tablet around to show it to Jimmy.

The changeling studied the picture. The left ear was a half-inch low, and so was the chin. Having seen her use the eraser, it applied it and corrected her work, completely redrawing the whole ear and chin. It added a small mole she had missed.

"What is that all about?" Grossbaum said.

"Amazing. I made a slight mistake in proportion, and he corrected it. Added the mole I'd left off." She set the tablet down. "Do you spend a lot of time looking in the mirror, Jimmy?"

The changeling didn't quite understand the question, but nodded, and then shrugged.

Most people can't draw freehand circles. Dutch did three concentric ones, and then tapped on Jimmy's tablet.

Again it slowed down its natural impulse, and again made a perfect copy.

"Jimmy, do you know the word for those?" Grossbaum said.

"Drawing," it said.

Dutch tapped the center of the picture. "These?"

"Circle," it said. "Circles."

"I wonder how much he knows," she said, "and can't talk about."

"Well, he knows about sex, although he's never discussed it. They caught him with a nurse."

The changeling nodded. "Nurse Deborah. She is kind . . . *was* kind. To me."

"They let her go."

Dutch looked Jimmy up and down. "They should have paid her extra. Poor kid must be going crazy."

"Crazy." The changeling nodded emphatically. "They say I am. Crazy."

"Are you?" she whispered.

"I don't know." Jimmy pointed at Grossbaum. "He should know."

"I don't know what's wrong with you, Jimmy. You do some things so well."

"You should know," Jimmy repeated.

"Bruno . . ." she touched Grossbaum's arm, "I think you may be inhibiting him. Could you leave us alone for a while?"

He smiled psychiatrically. "Would you report . . . everything to me?"

"You know me, Bruno." He did, in fact, very well.

He looked at his watch. "I do have a patient coming to the clinic at one. I could be back by 2:30."

"That should do."

He stood up. "Jimmy, I'll be gone for a while. Dutch will keep you company."

"Okay." The changeling understood part of the exchange. Dutch wanted to be alone with Jimmy. The way Nurse Deborah had.

After Grossbaum went out the front door, Dutch stared at the changeling for a long moment. "You don't remember what happened to you?"

"No." He returned her stare.

"How long ago was it?"

"One hundred eighty-three days."

"Do people who knew you before—your schoolmates—do they come by to visit?"

"They . . . do. They did. No more. He looked at the ceiling. "Since sixty-two days."

"You're lonely." He shrugged. "I could be your friend, Jimmy."

"You could?"

She stood up and held out her hand. "Show me around the place? I want to see how the other half lives."

The changeling was confused. If she wanted the kind of union that Deborah had, she was going about it in an indirect way. It took her hand, though—she squeezed it, and the changeling returned the soft gesture—and followed her out of the breakfast nook. They

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walked around into the kitchen.

It was spotless and elegant. Tile and gleaming enamel everywhere; a constellation of stemware hanging over a bar, shining brass pots and pans on the wall. A Mexican cook, small and fat and timorous, cowering in the corner.

"*Buenos días*," Dutch said, "*Jimmy me muestra la casa.*"

"*Bueno, bueno*," she said, and turned her attention back to the clean pot she was scrubbing.

Through the kitchen into the dining room, heavy mahogany table under a glittering crystal chandelier, gas converted to electricity. Old paintings on the wall.

A new painting over the fireplace in the formal living room, of Mr. and Mrs. Berry standing on a lawn with a little boy and a Dalmatian. "Is that you?"

"No." The changeling thought. "Was who was me."

The furniture in this room was antique, very English, reupholstered in a lush red velvet. It didn't see much use.

"It's hard to believe there's a Depression on," she said. The changeling shrugged. It had only heard the word in its psychological sense.

The music room was cheerful, north light flooding through a picture window that looked down over a formal garden. There was a Steinway baby grand and a harp.

She plucked the deepest bass string. "Do you play these?"

"No." The harp was new; he'd never tried it.

"That's surprising. I should think they would make you take piano lessons, considering . . ."

The changeling sat down on the stool, uncovered the keys, and played the opening bars of *Appassionata*.

Jimmy returned her stare. "I play this."

"I understand." It began to play soft chords in a strange rotation, not quite random. It didn't know the words for them, but they were alternating major and minor chords, wheeling on the flatted third. The effect was unearthly, not quite irritating.

She stood behind Jimmy and kneaded his well-muscled shoulders. "Could we . . . see your room?"

It stood up silently. This part it understood.

She walked demurely beside Jimmy, admiring his grace. "You get a lot of exercise?" He shrugged. "Swimming? Tennis?"

"I do those." Of course it could lie in bed all day and stay in perfect shape—or any shape it wanted. It was exactly the shape Jimmy had been when it dissected him.

They went through the library, yard after yard of books with uniform leather binding, into the main hall, parquet floor under a domed skylight of stained glass. Jimmy led her up wide curving steps to his floor, the third.

"Big place," she said. "Are you an only child?"

"Not a child." He opened the door to his bedroom.

"I suppose not." There was an incongruous hospital bed in one corner of the large room, and an elegant fourposter. It was still rumpled, the remains of breakfast on a serving tray. The wallpaper was beige silk. Double glass doors led to a balcony. She crossed the room and opened the doors and stood in the fresh breeze, salt air and flowers. Below her, two men were working on the formal gardens.

Behind her, Jimmy said, "Take off your clothes and put them on the dresser."

"We don't waste time, do we?" She stepped back into the room. "Why don't you take yours off first?" She went back to the door and locked it.

Jimmy pulled off his white cashmere sweater and the T-shirt beneath it, and stepped out of his sandals and white ducks.

She sat on the bed and ran a teasing finger down his chest and abdomen.

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When she touched his pubic hair, the penis sprang up like a tripped mousetrap.

"Take off your clothes," Jimmy said, "and put them on the dresser."

"Yes, sir." She smiled, realizing it was a stock phrase he must have learned from doctors examining him here. She undressed languorously, folding her clothes, carefully rolling her stockings. She turned her back to him when she stepped out of her knickers. She felt Jimmy's clasp on her waist and started to say something—and then there was a horrible stab of pain that forced the breath out of her. She gritted her teeth against screaming. "No, Jimmy! No!"

He picked her up like a large doll and threw her onto the bed.

It was a good thing she'd left the glass doors open; the gardeners heard her screams. Bad thing that she'd locked the door. By the time they had beaten it open, Jimmy was standing at the end of the bed, staring placidly at Dutch, who had crawled to the far corner of the large bed, cowering and whimpering and bleeding.

They knew better than to call the police. The one who spoke the best English called Mr. Berry at his law office while the others helped Jimmy dress and led him down to the pool. The Mexican cook and one of the male nurses tended to Dutch.

Mr. Berry showed up in ten minutes, bearing his most potent weapon, the checkbook. He listened to Dutch while she quieted her sobbing and haltingly described what had happened.

He was extremely sympathetic. Of course she was the victim here, but the law was complicated. Jimmy was, after all, a minor, and an unscrupulous lawyer might claim that she had seduced him.

She looked him in the eye, resolute through tears of pain. "I did start to seduce him. But then he raped me. Should I go to the police?"

Mr. Berry asked the others to leave the room. In a half-hour, an ambulance from a private hospital rolled up quietly to the service entrance, and Dutch was carried out over the gravel in Jimmy's old wheelchair.

The doctor who examined her had never seen a broken pubic bone before. He accepted her story about a bucking horse out of control, but suggested that during her confinement she might want to be examined for pregnancy, just in case.

He didn't know that the rapist could only reproduce by fission.

10. Apia, Samoa—2019

Transcript from a CNN news special, 14 December 2019.

Camera pans along gentle surf, to rest on the artifact. It closes in during voice-over introduction:

Mallory (VO)

Eight weeks ago, a mystery became an enigma. A private marine research organization, Atlantis Associates, had claimed salvage rights for an unclaimed wreck deep in the Tonga Trench a few hundred miles from this Samoan island.

With the help of Poseidon Projects, famous for having raised the *Titanic*, Atlantis used acres of floats to bring the "wreck" to within a few fathoms of the surface. They towed it with tugs to a holding location . . .

Archive footage of towing and parking the artifact.

Mallory (VO, cont.)

. . . just offshore of Independent Samoa, where they had secured a 99-year lease on a piece of undeveloped land, which was being turned into a small research center . . .

Archive footage of the shrouded artifact being pulled toward shore . . .

Mallory (VO, cont.)

. . . built solely to investigate this

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thing, which was obviously not the wreck of a ship.

Archive underwater footage: the shroud flaps teasingly, to show the bright metal surface of the thing. A montage of scenes while Poseidon engineers attach the towing collar to the artifact, and start dragging it in.

Mallory (VO, cont.)
That cable is powered by this machine (BEAT) . . . capable of moving thousands of tons.

But when this heavy thing—more massive than a Nautilus submarine, but smaller than a delivery van—when it came to the shoreline and dug into the sand —

Archive footage of the cable accident.

It had met its match. One man was almost killed when the cable broke.

They had to find a way to move it the last hundred yards, to the concrete pad that would become the floor of their laboratory.

Fade to LIVE image on the thing with its rocket attached.

This is a self-contained Chinese booster rocket, normally used in the Glorious Wonder series, to carry up to a ton into low Earth orbit.

It's not going quite so far today.

An improvised bunker a couple of hundred yards from the thing. You can see the artifact through a thick window. Mallory is sitting with two men, drinking coffee at a table made of a plank on stacked boxes.

Mallory
We're going to watch this with Jack Halliburton and Russell Sutton, joint directors of Atlantis Associates.

I suppose this is going to be the shortest rocket trip in history.

Jack
There were some last century that only got an inch off the pad.

Russ
This one's reliable as a Ford truck though. Except . . .

Mallory
What could go wrong?

Jack
We're not worried about the rocket. Just its attachment to the artifact.

Russ
It's the irresistible force versus the immovable object.

Jack
We know the thing's mass; we know the properties of the sand it's resting on. The rocket generates plenty of thrust to do the job.

Russ
The only problem is the attachment between the rocket and the artifact. If the collar that connects them breaks . . . we'll need another approach.

Mallory
And the rocket goes screaming into the center of town there?

Telephoto zoom from the rocket's POV straight into Maggie Grey's.

Jack
No, there's an automatic shut-off, if the rocket suddenly feels no resistance. It might go fifty or a hundred feet.

Mallory
But if it doesn't work?

Jack
Glorious Wonder carries a lot of insurance.

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Russ
A lot of people in Apia are off visiting relatives in the country. I think I would be, too.

A loud whistle blows.

Jack
That's the ten-minute warning. You might want your cameraman out of there.

Mallory stands up and looks through the glass—

Mallory
They're gone. Just the camera attached to the booster.

Russ
I hope it doesn't give you anything too interesting.

Mallory
Have to agree, for once. (BEAT) So this has to be some artifact from outer space.

Russ
Well, you know as much about that as we do. It could possibly be the result of some natural process we've never encountered before.

Jack
Though its density makes that unlikely. Or inexplicable.

Mallory
It's very ancient.

Russ
The coral it was imbedded in was old before there were any primates resembling humans.

Mallory
So you don't think much of the "lost weapon" theory?

Jack
Bullshit.

Russ
You do have to wonder how it got there, if it's an old Soviet or American device. If we'd just found it lying someplace, sure, that would be the first assumption. But it was *below* million-year-old coral.

Mallory
So maybe they hid it there?

Russ
You'd have to ask why. I'd want to hide it in my own country.

Mallory
Have the Russians or Americans contacted you?

Jack
Sure.

Russ
We don't want to talk about that. Yet.

Aerial view with countdown superimposed. 360-degree pan shows all the military helicopters watching. At 10 seconds, it zooms in on the artifact. A laconic VOICE OFF counts down.

Voice (OFF)
Ten.

Jack
(rising)
About time.

The three of them move to the window to watch. SPLIT SCREEN with the aerial view. Voice (OFF) counts down to zero.

The Chinese rocket ignites, its exhaust churning billows of steam in the sea behind it. For long seconds, as the noise increases to a banshee scream, it doesn't move. Then the artifact lurches and moves slowly, then faster, up the guide rails toward the metal cradle

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that will be its resting place. A camera by the cradle shows it fall into place with a jarring crash, just as the rocket goes silent.

Russ
Textbook. Those Chinese are pretty damn good.

Jack
Glad they're on our side. For the time being.

11. San Jacinto—1932

The Berrys had to admit that Jimmy was unmanageable, and quietly had him committed to St. Anthony's, a private insane asylum.

It was a valuable change of venue. The drugs the changeling was compelled to take by mouth or injection were metabolically insignificant. The shock treatments, where they wrapped you in wet sheets and splashed you with buckets of ice water, were gently stimulating to a creature who could live on Mercury or Pluto.

But the changeling was surrounded by extremes of human behavior, in both the patients and their attendants, that it would never have seen at the mansion. It learned more in its first week than it had in months of cosseted coddling.

The guards were brutal and stupid. If the changeling did anything outside of a certain range of behaviors, they would wrap it in a straitjacket and throw it in the rubber room.

It came to understand coercion and confinement. It could have slipped out of the straitjacket, prefiguring Plastic Man, and kicked down the door like Superman. But there would be no education in that. It submitted to beatings and rapes—rich pretty boy who can't tell on you. It learned something like sympathy for Dutch, though pain was just input to it, and humiliation was not yet in its emotional range.

It listened to the other patients when they had social time together. That it responded in monosyllables, sometimes bizarre, went unnoticed. In fact, it was getting a slow, and somewhat skewed, version of the learning process that a human child would go through. It "grew up" by observation and assimilation.

A large part of the puzzle was human linguistics, and the ultimately related problem of mimicking human thought processes. It took two years, but by the time "Jimmy" was twenty, no one was beating or raping him. He was moved into a clean, quiet part of St. Anthony's, and after awhile was allowed to have visitors.

His parents were so glad to see him acting "normal" that they overlooked the fact that he didn't act like Jimmy at all. He was released into their care.

The changeling had assimilated a wide range of behaviors, and a fairly sophisticated sense of which was appropriate at which time. To the Berrys, their son had become quiet and dignified and perhaps a little shy, which was a real advance over the brutal sodomist they'd tendered to St. Anthony's.

The changeling played piano for hours at a time, and it also spent a long time just watching the sea. It knew it was being observed and evaluated, this time by amateurs, and could deliver a nuanced performance.

It had learned how to simulate the behavior of a teenager who had been troubled, but now was on the road to recovery. It had seen that that was the only way to get out of St. Anthony's and move on to the next stage of development.

This was the most complex creature it had ever imitated. Its successes gave it a pleasure like joy.

12. Apia, Samoa—2020

Once the artifact was seated on its pad, a gang of workers paid extra for speed and overtime began building the laboratory around it. The government moved in before the drywall was up.

Halliburton and Russell had come

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down from their hotel lunch to take a look at the building's progress. They crossed over the moat on a makeshift bamboo bridge and let a supervisor show them around the place. He claimed they could begin moving in equipment in four days; the trim and painting would be done in five. That was better than they'd contracted for.

When they started to go back, there was a man in a white tropical suit waiting on the other side of the moat, an uncomfortable-looking guard at his side.

"Mr. Halliburton, he—"

Halliburton cut him off with a gesture. "Who are you and who are you working for?"

"Dr. Franklin Nesbitt," he said, "Chief of NASA Advanced Planning." He was a tanned muscular man with close-cropped white hair who stood absolutely still, except for offering his hand.

Russell took it. "We've had correspondence."

"Of a sort," Nesbitt said. "You basically said that whatever I was selling, you weren't buying."

"That's still true," Halliburton said. "You have no jurisdiction here."

"Nor claim any. But I have an offer you might find interesting."

"No, you don't. You've come a long way for nothing."

"Jack," Russell said, "we can at least be civil." To Nesbitt: "They're serving tea at the hotel. It would be nice to talk to somebody who isn't a reporter." He called ahead while they walked to the Jeep, and by the time they got to the hotel their private dining room was set with crisp linens and heavy silver.

An Irish woman brought in tea and trays of trimmed sandwiches and pastries.

"My indulgence," Russell said. "Jack is more like beer and potato chips."

"Total barbarian," Halliburton said, snagging a watercress sandwich as he sat down. "So what do you have that's so interesting? What do you have that's *interesting* at all?

The other two men waited while the woman poured tea and left. "General or specific?" Nesbitt said.

"General," Russell said.

He rubbed his forehead, and for a moment you could see the seven time zones of jet lag.

"Basically, and expecting initial rejection, I'm offering you our expertise for free."

"Right about that," Jack said. "The rejection."

"If we did seek outside help," Russ said, "why should it be you rather than the Europeans or Japanese?"

"We're older and larger—not in terms of money, true, but as a research organization."

"We are doing research here," Jack said, peering doubtfully into a sandwich, "but we're primarily a for-profit organization. One that doesn't have the faintest idea of what it will find. But we have a good chance that it will be earth-shaking.

"I've sunk most of a large fortune into this. I took on Dr. Sutton and his team because I felt I could trust them. In exchange for keeping their work secret, they are limited partners as well as salaried employees: if things go well, they all get a small percentage of what should be an astronomical return. If there's any leak, anything, they all get nothing."

"We're prepared to allow you to keep all financial returns from anything our people discover."

"People. That's the problem, Dr. Nesbitt. As an organization, NASA can promise anything it wants. But if one of your *people* stumbles on an anti-gravity machine, I think he or she might trade a job with NASA for limitless wealth."

Nesbitt nodded amicably, tasted his tea, and sifted some sugar into it. "Your investment is, what, about a third of a billion Eurodollars?"

"Close enough."

"Then let me go from the general to the specific. We're prepared to match

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your funds. Wipe the slate clean."

"In exchange for?" Russ asked.

"A team of twelve researchers who would clear every publication with you, and also assign any present or future profits to you." He looked at Jack over the rim of his teacup and sipped. "Up in my room I have a long contract to that effect, which I'm told covers everything. Also, dossiers of the twelve."

"Including you?"

"I wish, but no. I'm just an administrator who loves science. I don't think you'd be impressed by my physics B.S. from Arkansas."

Jack smiled. "Maybe more by that than by your MBA from Harvard." He tapped his hearing aid. "Wonderful machines, these."

Nesbitt didn't blink. "Is it tempting?"

"Of course it is," Jack said harshly.

"Jack, we agreed from the get-go. No government. No military applications."

"We'd be amenable to that. It's not what we're looking for."

"What *are* you looking for?"

"Half our team are exobiologists. It's not so much a 'what' . . . as a 'who.'"

13. Woods Hole, MA.—1935

The Berrys were surprised when their son didn't want to go to Juilliard, which they certainly could have afforded. The changeling was interested in music, but its interest was not human, and it could be indulged anywhere. It could sit alone in the dark and play, in its mind, fantastic compositions that no human could play. With two extra imaginary hands, it could play a Bach fugue forward and backward at the same time. It often did things like that in the hours it had to feign sleep.

All it really knew of its origin is that it had come from the sea, and before taking human form it remembered having been for centuries a great white shark and a killer whale. There were other manifestations before that, and though the memories were vague, it seemed they had all been sea creatures of some sort.

Were there a lot of its kind? There was no way to tell. Others who had taken human form could pass for human indefinitely, appearing to age at a normal rate, "dying," and resuming life as someone else.

Its readings in psychology indicated that its transition, while it was learning the difference between killer whale behavior and human behavior, cannot have been common. There were tales of "feral children," supposedly raised by wolves or other animals, who might fit the pattern. He had plenty of time to investigate that.

There was no compelling reason for someone like it to become human. They could still be great white sharks or killer whales—or coral reefs or rocks, if that made them content. The sea was a good hiding place.

So it decided that oceanography would be a reasonable place to start. If that didn't pan out, it could study some other discipline, switch identity and do it again and again. Time was of no importance.

The leading edge of oceanographic research was Woods Hole, a new, privately endowed institution. It was in Massachusetts, so the changeling applied to several places in that commonwealth. Turned down by both Harvard and MIT, possibly because most of its high school courses had been taught by home tutors, it wound up going to the University of Massachusetts, majoring in oceanography. Woods Hole did take graduate students from there as summer interns, and that was its eventual plan.

Its academic performance was predictably irregular; it aced anything that had to do with logic or memorization, but didn't do well in courses like literature or philosophy. It saw that many other students were that way, and most of them were shy loners, too.

After part of one semester of dormitory life, it moved out and got an apartment in town. That minimized the time

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and energy devoted to maintaining the Jimmy Berry façade, and gave it freedom to practice being other people, which it assumed would someday be a useful talent. After careful practice, it could become a different person of the same size in about ten minutes. Smaller or larger took twice as long or more, and was more painful and tiring. Once it became two children, though one had only average intelligence, and the other was dimwitted.

It had a cautious social life as Jimmy, going to a dance or the movies once or twice a month, always with a different girl. There was no shortage of dates, for a handsome older California boy with money and family. There was no record of Jimmy's peculiar past in regard to the opposite sex, and in 1932, sex never became an issue on the first and only date.

(The changeling realized it would sooner or later have to learn sexual etiquette, but decided to put it off until later. There was almost no reliable information on the subject in America at that time; people in movies and books made obvious sexual overtures, but never followed through. It knew that "take off your clothes and put them on the dresser" would only work under certain conditions. You did have to wind up alone and in a state of undress together, but how you got there from the passionate kiss or arched eyebrow was a mystery.)

So its course was set: four years of work that shined in science and mathematics and language, but little else, which was good protective coloration, and then a couple of years on a Master's, then a doctorate and, eventually, Woods Hole.

It did get to work at Woods Hole for two summers, sailing the ketch *Atlantis* as a graduate intern. Every now and then, on days off, it would go to a deserted cove and spend an hour changing into a dolphin, to get back to the sea in a more personal, familiar way. These cold rich waters were another world from its Pacific home, and it learned a lot, some of which would direct its own research.

But before the doctorate came, war intervened.

The changeling saw people being drafted and assigned to whatever kind of job and place the military desired. But people who joined up were allowed to choose, within reason.

It wanted to study the Pacific, suspecting its origin must be somewhere out there. Danger wasn't a factor; as far as it knew, it couldn't die. So it joined the Marines, and asked for a Pacific assignment.

To most graduate students, it would be an annoyance and delay—not to mention the possibility of being shot or succumbing to some tropical disease. But to the changeling, time was just time, meaningless. Every new experience had been useful.

It didn't tell the Marine Corps about college, which probably would have led to a desk job. So instead of being a marine science Marine, it became a plain footsoldier, grunt, jarhead. Pearl Harbor was a year away.

14. Eurasia—pre-Christian era

The changeling wasn't alone on the planet. There was another creature, unrelated, who had lived on Earth longer than he could remember; who had lived thousands of lives, disappearing when he got too old, to reappear as a young man.

He was always a man, and usually a brute.

The chameleon was an alpha male who never had sons, unless an adulterer cooperated. Unlike the changeling, he did have DNA, but it was alien; he could no more reproduce with a human than he could with a rock or a tree.

Also unlike the changeling, he seemed to be stuck in human form. It never occurred to him to wonder why this was so. But it didn't occur to him for tens of millennia—not until the Renaissance—that he might have come from another world. He assumed that he was

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some sort of demon or demigod, but early on realized that it was a mistake to advertise the fact. He couldn't be killed, not even by fire, but he did feel pain, and he felt it profoundly, in ways a human never could. To be burned to ashes is agony beyond belief. But reconstructing yourself afterwards is worse.

So after a few experiences that probably helped establish the myth of the vampire, the chameleon settled into routine existence, seriatim lives that were fairly ordinary.

He was usually a warrior, and of course a good one. Sometimes his career was cut short by being chopped in two or trampled or drawn and quartered. In the chaos of battle he could usually find a few minutes of darkness, to pull himself together, and then go off in search of another life. When his death and interment were witnessed by many, he had to fake a grave robbery or, reluctantly, a miracle.

In ancient times, he occasionally wound up being a warlord or even a king, by dint of superiority in battle and an instinct to advance. But that was always more trouble than it was worth, and made it almost impossible to arrange a private death and resurrection.

Like the changeling, he was a quick study, but he was a sensualist, indifferent to knowledge. All he needed to know in order to survive, his body already knew. The rest was just for maximizing pleasure and minimizing pain.

He picked the right side in the Peloponnesian Wars, and went through several generations as a Spartan. Then he joined Alexander's army and wound up settling in Persia. He spent a century or so as a Parthian before he eased into the Roman sphere.

It was as a Parthian that he heard the story of Jesus Christ, which interested him. Killed in public and then resurrected, he was evidently a relative. He would keep an eye out for him.

The chameleon entered the history books only once, and it was because of his interest in Christianity. In the third century, in Narbonne, he was a captain of the Praetorian Guard, and was a little too open in his curiosity about the fellow immortal. An enemy reported him, and Diocletian had him executed as a closet Christian, by archers. But his girlfriend, Irene, wouldn't leave him alone to die, and he "miraculously" recovered. Diocletian subsequently had him beaten to a pulp by soldiers with iron rods, whereupon Irene let him stay dead long enough to turn into a young soldier and escape, leaving behind the legend of Saint Sebastian.

He worked as a farm hand and soldier in Persia until 313, when the Edict of Milan made it safe to be a Christian. When he heard about that, he dropped his plow and walked to Italy, robbing people along the way, just enough to get by.

He didn't like being so close to authority, so he went back to France and shuffled between Gallia and Germania for awhile, keeping an eye out for other immortals. Things got ugly in the 542 plague, so he made his way over to England as part of the Saxon invasion.

England seemed more congenial than the Continent, as the Roman empire collapsed into chaos, and the chameleon lived many lifetimes there, first as soldier and farmer, but eventually learning a variety of trades: blacksmith, cobbler, butcher.

In 1096, he went back to soldiering, following the Crusades down to Jerusalem and beyond. He fought on both sides for a century or so, and eventually, as an Arab, went back to Egypt and started walking south along the Nile.

Making himself dark and tall, he became a Masai warrior, and it was the best life he'd yet encountered: lots of women and great food and, in exchange for a battle every now and then, he could sleep late in the morning and hunt for game with spears, which he enjoyed. He did that for more than a thousand years, still keeping an eye out for

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Christ or another relative, probably white.

But the first white people who showed up were bearing guns and chains. He could have resisted and conveniently "died," but he'd heard about the New World and was curious.

The ride over was about the worst thing he'd ever experienced—right up there with being boiled in oil or flayed to death. He lay in chains for weeks, stuffed in an airless hold with hundreds of others, many of whom died and lay rotting until someone got around to throwing them overboard.

It was a real chore. He thought about just bursting his chains, at night, and diving into the sea. He'd done that before, in Phoenicia, and swam dozens of leagues to shore. But Africa, after a few days under sail, would be months of swimming, so he'd just be trading one agony for another.

So he allowed himself to be carried to America, and in a way enjoyed being put up on the block—he was by far the healthiest specimen off the ship, since metabolism was irrelevant to him, other than as a source of pleasure. The Georgia man who bought him, though, was cruel. He liked to whip the new boys into submission, so at the first opportunity, the chameleon killed him, and then turned into a white man and walked away.

That was an amusing time. His version of English was almost a thousand years old, so he had to masquerade as an idiot while he learned how to communicate. He walked north, again robbing and murdering for sustenance, when he knew he wouldn't be caught.

He kept moving north until he got to Boston, and settled in there for a few hundred years.

15. Apia, Samoa—2020

"Little green men," Halliburton said, staring at Nesbitt. "You've been reading the tabloids."

"The thing is at least a million years old," Russell said.

Nesbitt nodded. "But it's obviously a *made* thing."

"Maybe not," Russell said. "It could be the product of some exotic natural force."

"Assume not, though. If some intelligence made it a million or some millions of years ago . . . well, we can't say anything about their motivation, but if they're like humans at all, there's a good chance the thing is inhabited in some sense."

"Still alive after a million years," Halliburton said, stacking up two little egg salad sandwiches.

"We're still alive after more than a million years."

"Speak for yourself, space man."

"I mean humanity, since we evolved from *Homo erectus*. We've been traveling through space in a closed environment, growing from a few individuals to eight billion."

"It's a point," Russ said. "That thing is a closed environment, in spades."

"Your eight billion little green men are going to be *tiny* green men."

"Well, it's probably not full of little hamsters in space suits," Nesbitt said. "It may not be inhabited in the sense of carrying individuals. It could have some equivalent of sperm and eggs, or spores—or it could be basically information, like a von Neumann machine."

"Oh, yeah. I sort of remember that," Russ said.

"I don't," Halliburton said. "German?"

"Hungarian, I think. It's an early nanotech idea. You send little space ships out to various stars. Each one is a machine, programmed to seek out materials and build two duplicates of itself, which would take off for two other stars."

"Yeah," Russ said, "and after a few million years, every planet in the Galaxy would have been visited by one of these machines. The fact that there obviously isn't one on Earth is offered as proof that there's no other space-faring life in the

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Galaxy."

"That's a stretch."

Russ shrugged. "Well, the Galaxy is thousands of millions of years old. The logic is that the project would be relatively simple to set up, and then would take care of itself."

"But you see the hole in that logic," Nesbitt said.

"Sure," Jack said. "I see where you're going. The argument assumes we would know the machine was here."

"It might well be hidden," Nesbitt said; "hidden in a place where it wouldn't be found except by other creatures with high technology."

Jack rubbed the stubble on his chin. "You're right there. No pearl diver's gonna find that thing and bring it up."

"And bringing it out of that environment into this one might be a signal that life on the planet has evolved sufficiently to initiate the next course of action."

"Make contact with us."

"Maybe. Or maybe eliminate us as rivals." He looked at both of them in turn. "What if a creature like Hitler had started the project? Ghengis Khan? And they were at least *humans*. There are plenty of animals who simplify their existence by eliminating their *own* kind who threaten their primacy. We ourselves have destroyed whole species—smallpox and malaria—for our health."

"It's far-fetched," Halliburton said.

"But even if the probability was near zero, the stakes are so high that the problem should be addressed."

"Hm." Jack tapped his teacup with his spoon and the woman appeared. "Sun's over the yardarm, Maggie." She nodded and slipped away. "So how are your twelve people supposed to save humanity from alien invasion?"

"We discussed moving the whole operation to the lunar surface."

"Holy cow," Russ said.

"It would make the Apollo program look like a Science Fair project," Nesbitt said. "No one has a booster that can orbit one tenth that thing's mass. And we couldn't send it up piecemeal."

Jack squinted, doing numbers. "I don't think it could be done at all. Mass of the booster goes up with the square of the mass of the payload. Strength of materials. Goddamn thing'd collapse."

"And you see the implications of that. Someone got that thing here from a lot farther away than the moon."

"That's still just an assumption," Russ said, "and I still lean toward a natural explanation. It probably was formed here on Earth, by some exotic process."

Nesbitt's temper rose for the first time. "Pretty damned exotic! Three times as dense as plutonium—and that's if it were the same stuff through and through! What if the god-damned thing's hollow? What's the shell made of?"

"Neutronium," Russ said. "Degenerate matter. That's my guess, if it's hollow."

"Baloney-um is what we called it in school," Jack said. "Make up the properties first; find the element later."

Maggie rolled in a cart with various glasses and bottles. "Gentlemen?" The NASA man stuck to tea, Russ took white wine, Jack a double Bloody Mary.

"So what does your dynamic dozen propose?" Jack asked as the woman left the room.

He leaned forward. "Isolation. More profound than extreme biohazard. The environment the military uses in developing . . ."

"Nanoweapons," Russ supplied. "Of course we're not *actually* developing them. Just learning how to defend ourselves against them, if somebody else does."

"Well, it's not just the military. Everybody developing nanotech uses similar safeguards to keep the little things isolated.

"We'd cover the lab building your crew is finishing now with an outside layer, sort of an exoskeleton. Basically a seamless metal room almost the same size as the lab. To enter, you have to go through an airlock. The atmospheric pressure inside is slightly lower than out-

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side. The airlock's also a changing room; nobody ever wears street clothes into the work area."

"I don't think our people would enjoy working under those constraints," Russ said. "Feels like government interference."

"You could also see it as taking advantage of the government. We give you the functional equivalent of lunar isolation—air and water recycled, power sources independent of the outside."

"Plus getting back all the capital we've put in, to date?" Jack said, looking at Russ.

"That's right," Nesbitt said. Russ nodded almost imperceptibly.

Jack squeezed some more lime into his Bloody Mary. "I guess we'll look into your contract. Have our lawyers look into it. Maybe make a counter-offer."

"Fair enough." Nesbitt stood. "I'll go up and fetch it. I think you'll find it clear and complete."

What they wouldn't find was a little detail about the "independent power source": As a public health measure for the planet, its plutonium load could be command-detonated from Washington, turning the whole island into radioactive slag.

16. Amherst, MA.—February, 1941

The changeling could have avoided the draft by simulating any number of maladies or deficiencies; one out of three American men were rejected. Like a lot of men, for various reasons, he avoided it by joining the Marines.

The Corps was not enthusiastic about recruits like Jimmy Berry, no matter how good they would look on a recruiting poster. He was tall, strong, handsome, healthy, and obviously from a rich family. He was probably lying about not having gone to college, to get out of being assigned to Officer Candidate School. He would be hard to break, which would make it that much harder to break the other shitbirds. And they had to be broken before they could be built anew as Marines.

They called him Pretty Boy and Richie Rich. But he was a little more of a problem than they'd anticipated. On their way to their first day in barracks, a big drill sergeant called him out of ranks—"you march like a fuckin' girl"—and made him do fifty push-ups, which he did without breaking a sweat. Then the sergeant sat on his back and said, "Fifty more." He did these with no obvious effort.

So the first night, the drill sergeant organized a "blanket party" for the annoying shitbird. He got four big sergeants and three big corporals to throw a blanket over the sleeping Jimmy and beat some respect into him.

It was two in the morning and the changeling, mentally playing the piano with four hands, heard the seven tip-toeing down the aisle of the barracks, but dismissed the sound as unimportant. Nothing here could hurt it.

But when the blanket suddenly was wrapped tightly around it and someone struck it with a club, it did fight back for less than second. Then it figured out the situation and was totally passive.

In less than a second, though, it had broken a wrist and two thumbs, and had kicked one man across the room, to get a concussion against the opposite wall.

One of the survivors kept swinging the club at Jimmy's inert form, until the others hustled him out. Then the recruits, by ones and twos, came over to see what damage had been done.

The changeling manufactured bruises and cuts and released an appropriate amount of blood. It was ghastly sight in the dim light from the latrine. "We have to get him to the infirmary," someone said.

"No," the changeling said.

The overhead lights snapped on. "What the fuck is going on in here?" the drill sergeant roared. He was wearing clean pressed fatigues, but the shirt was only buttoned halfway, and his left hand hung useless at his side, the thumb turn-

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ing purple and blue. "You shitbirds get back to your bunks."

Two noncoms sidled by him to the unconscious one lying by the wall. He moaned when they picked him up and hustled him away.

The drill sergeant stood in front of Jimmy, inspecting his bruises and cuts and two black eyes. "What happened to you, recruit?"

"What do you think happened, sergeant?"

"Looks to me like you fell out of your bunk."

"That must be it, sergeant."

"Will you need medical help?"

"No, sergeant."

"*LOUDER!*" he screamed.

"*NO, SERGEANT!*" The changeling matched his tone and accent perfectly.

"Good." He wheeled and marched back toward the door. "You shitbirds didn't see nothin'. Get to sleep. Formation at 0500." He snapped off the lights.

After a minute of silence, people started to whisper. The changeling sat upright in its bunk. Someone brought him aspirin and a cup of water.

"Where'd you learn to fight like that?"

"Fell out of bed," it said. "So did the sergeant."

That was repeated all over the camp, especially when the next morning they had a new drill sergeant, and the old one was nowhere to be seen. They gave the changeling the nickname "Joe Louis."

The new drill sergeant was not inclined to single out Joe Louis. But he didn't favor him, either. He had eight weeks to turn all these pathetic civilians into Marines.

For the first week they did little other than run, march, and suffer through calisthenics, from five in the morning until chow call at night—and sometimes a few more miles' run after dinner, just to settle their stomachs. The changeling found it all fairly restful, but observed other people's responses to the stress and did an exactly average amount of sweating and groaning. At the rifle range, it aimed to miss the bulls-eye most of the time, without being conspicuously bad.

It almost made a mistake at the gas-mask training "final exam." One at a time, the recruits were led into a darkened room where they had to wait until the gas-masked sergeant within asked you for your name, rank, and serial number. You gasped them out and then quickly put on your gas mask, saluted, and left.

The changeling walked into the dark room and took a breath, and was almost overcome with an inchoate rush of nostalgia. It had forgotten, after a million years, that its home planet's atmosphere was similar to this, about 10 percent chlorine. The smell was delightful.

The sergeant with the gas mask and clipboard let it wait for about two minutes. Then he turned a bright flashlight into its eyes. "Are you *breathing*, Private Berry?"

"No, sir."

"Don't call me '*sir*'; I work for a living." He kept the flashlight steady for another minute. "I'll be god-damned. You swim a lot, Private Berry?"

"Yes, sergeant."

"Underwater, I guess?"

"Yes, sergeant."

He paused for another thirty seconds and shook his head. "*Dang*! Give me your name, rank, and serial number, and put the mask on." The changeling did. "Now get the hell outta here before you puke all over me."

The changeling went through the door where the EXIT sign glowed dim green, enjoying the last whiff of chlorine trapped inside the mask.

Outside, twenty men were sprawled around in various attitudes of misery, coughing and retching. There were spatters and pools of vomit everywhere. The changeling ordered his stomach to eject its contents.

A friend, Hugh, came over to where he was kneeling and pounded him on the back. "Jeez Louise, Jimmy. You mus-

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ta held your breath three minutes."

The changeling coughed in what it hoped was an appropriate way. "Swim a lot underwater," it said breathlessly. "God, don't that stuff smell awful?"

But the memory of nostalgia was strong. Where on Earth could it have lived, where chlorine was so concentrated in the air? Nowhere on the surface. That would be a good research project, after the war.

A lot of their training had a quality of improvisation, since much of the materiel of war had already left for the Pacific. So they learned how to work with tanks by advancing in formation behind a dump-truck carrying "TANK" signs wired to its front and rear. They carried World War I Springfield rifles and practiced with them on the range.

Hand-to-hand combat training was a ballet of restraint for the changeling, who had been a remorseless predator for most of its life. It allowed the other trainees to throw it around and simulate dangerous blows. When it was *its* turn to be aggressive, it spared everyone's lives, knowing it could rip off one person's leg and beat everybody else to death with it.

It was properly respectful to the sergeants, and studied their individual ways with the men. Those techniques were more interesting than the coercive strategies of college professors, who presumably had intellectualized the process. The sergeants instinctively reached back into primate behavior, becoming the dominant male by shoving and punching and screaming. Anyone who resisted them was punished—immediately and then again later, with assignments, "shit details," that were degrading and exhausting.

The changeling did its share of those—cleaning toilets with a toothbrush and pulling twenty-four-hour Kitchen Police—not, of course, because it had *actually* lost its temper or misread the sergeants' desires. Too much self-control would make it conspicuous. It had to play the game.

17. Apia, Samoa—2020

Russ and Jack, especially, agonized over the contract, distrusting the government on principle, but unable to deny either the financial argument or the scientific one. They faxed it to their Chinese and stateside lawyers, and they agreed that it was what it claimed to be.

They signed it on Friday, and on Saturday morning their work crew was suddenly tripled, cargo helicopters thrumming in hourly with the prefabricated materials for their laboratory's exoskeleton.

The carpenters and painters who were putting the finishing touches on the lab were nonplussed, to say the least. The elegant heat exchange system was carved away and replaced with heavy-duty machinery. The carefully glazed windows that looked out on the ocean now had a view of plain steel plate.

The moat was filled with fast-setting plastic concrete that supported the footers for the new metal walls and roof. NASA dug a new moat, wider and deeper and open to the sea: the lab became an artificial island fortress.

The twelve scientists, seven women and five men, were sensitive to turf. They never approached the artifact unaccompanied by the original team; they spent hours every day comparing notes with them, planning out approaches. It was a congenial, collegial mix, everyone linked by passionate curiosity.

None of the NASA scientists knew that the SNAP-30 reactor had been modified so that it could function as a bomb. Some of the mass that they thought was shielding was actually extra plutonium. Nesbitt had known, but his first allegiance was to the NSA, "No Such Agency," not NASA.

And he was no longer in the picture.

The NASA team was "all chiefs, no Indians," officially, but their nominal leader was Jan Dagmar, a white-haired

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exobiologist old enough to remember the first moon landing and young enough to go cave-diving for fun. She had advanced degrees in both physical and life sciences, on top of a B.A. in philosophy.

Her eleven compatriot scientists worked daily with the members of the original Poseidon team, and they worked together with them away from the site, too, comparing notes, planning out approaches. They all lived together in the Vaiala Beach Cottages, where #7 was designated the common room, a big coffee urn always going, refrigerator and pantry full of food for thought.

Russell spent a lot of time in #7, and had moved into #5, leaving the fancy suite at Maggie Grey's, a ten-minute bicycle ride away. Jack stayed at his, saying he could think better in air conditioning.

They all agreed, although Jack was characteristically impatient, to wait until the isolated environment was finished before starting their tests. So they had eight days of brainstorming their approaches. Equipment and supplies came in daily from Honolulu, Sydney, Tokyo.

The night before the first tests, Russ called Jan and they met at the rocks overlooking the site to share a bottle of the best champagne he could find in Samoa. The relationship that was developing between them was not exactly romantic in a conventional sense, but they had discovered in each other a kind of romantic reverence toward nature and science that went back to childhood.

They shared champagne and a pair of powerful binoculars, studying the crescent moon in the clear dark sky. The nightglass stabilizers hummed and clicked while he looked down the terminator edge and named the craters—Aristarchus, Messier, Globinus, Hell. "That's a deep one," he said.

She laughed. "I used to know some of the names. My dad had a telescope."

"You said they moved down to Florida to watch the moon rockets."

She nodded in the darkness. "And all the other ones, the shuttle and all. But the Apollo rockets were the biggies—Saturn V's. Deafening; you could feel the noise rattling your bones. And dazzling, the one they did at night."

"That was the first one?"

"No, the last. The first one was Apollo 11, in 1969."

"Oh, yeah. I slept through it, my mother said. I was not quite two."

"I was twelve," she said, refilling her glass. "The first time I ever tasted champagne. Still makes me think of it."

They stared out over the project into the night, in companionable silence. The dim yellow security lights attracted bugs; small birds swooped out of the darkness. "This may be even bigger," she said. "It almost certainly will be."

"Even if it turns out to be homegrown," he said. "We'll have to totally rethink physics and chemistry."

"Chemistry *is* physics," she said automatically. "Tell you what. If this thing turns out to be terrestrial in origin, I'll buy you the most expensive bottle of champagne in the Honolulu duty-free."

They clicked glasses. "If not, I'll buy you two."

"What, you're that skeptical?"

"Hell, no; I agree with you. But I've got an expense account, and we'll need a consolation prize."

A test area, about four inches square, was marked off by tape on the artifact's side, about midway. An electron microscope and its positron equivalent could be easily brought to bear on the area. They built a forced-draft hood over it, to suck away and analyze poisonous vapors.

First they measured it passively. It had an albedo of exactly 1.0—it reflected all light that fell on it, in every wavelength. Optically, it presented a perfect curve, down to 1/200 wave, a surface impossible for a human optician to duplicate.

Although it looked like metal, it felt like silk; it wasn't cold to the touch. It

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was not a conductor of heat, nor, as far as passive testing could tell, of electricity.

Then they went to work, trying to dent it. Scrape it, corrode it, chip it, burn it—do anything to make the artifact acknowledge the existence of humanity.

When it was still underwater, Poseidon divers had tried a diamond-tipped drill on it, to no effect, but now they rolled in a huge mining drill: it used a 200-horsepower electric motor to spin its diamond tip at 10,000 r.p.m., with more than a ton of force behind it.

The scream it made was too much for the scientists' earplugs; they had to rig a remote control for it. At the maximum push, just before the diamond tip evaporated, it shattered all the useless windows and ruined the positron microscope beyond repair.

The electron microscope worked, though, and all it showed was a film of oxides from the metallic part of the ruined drill bit. When they cleaned that off, even at the highest magnification there was no difference between the test square and the undrilled surface next to it: a perfect mirror.

18. Bataan, P.I.—7 December 1941

Many of Jimmy's boot camp compadres steamed across the Pacific with him, to join the 4th Marine Regiment in Shanghai. They arrived in November 1941, and barely had time to get their land legs before they were ordered to sail again, this time for the Philippines, assigned to provide beach defense for Corregidor.

The naval command knew it was only a matter of time before Japan attacked American forces in the Pacific. America had severed trade ties with Japan in July, and frozen her assets in American banks. The Navy and the Army set about redistributing their meager forces to places that seemed most vulnerable to attack. That included the Philippines, which blocked Japanese access to the East Indies.

The 4th Regiment set up shop in Corregidor and sent a detachment, including Jimmy, south to the small base at Bataan. They called it a "shit assignment," one step farther away from the amenities of Manila, but they didn't know how terminally bad it was going to become.

When the Japanese hit Pearl Harbor on the morning of the 7th (which was the 8th on Jimmy's side of the International Date Line), there was an immediate air raid alert in Manila and American fighters and bombers scrambled into the air to do battle. The timing was off, though; there were no Japanese in sight. They landed again, and when, a few hours later, the Japanese *did* come screaming out of the sun, there was no warning for the planes on the ground.

Bataan and Corregidor were constantly bombed and strafed, with little or no help from the air. Meanwhile, Japanese land forces were coming ashore to the north, in Luzon and Mindanao.

The original War Plan, before Pearl Harbor, had called for all American forces to go south to Bataan, and maintain a holding action there, delaying the Japanese advance into the East Indies. Instead, General MacArthur moved his forces up to meet the Japanese where they were landing.

MacArthur had at his disposal 120,000 Filipino troops, most of them reservists who had never fired a shot, and one tenth that many Americans. They had the Japanese outnumbered but not outgunned, and the defensive move was an unmitigated disaster. He went back to the original plan on 27 December, and within a week all the Northern Luzon forces were sharing Bataan's limited resources with Jimmy. They were soon joined by thousands of Filipino civilians, fleeing the invaders. In two weeks, everyone's food ration was cut in half; in February, they were reduced to 1000 calories per day, mostly rice. They got a little tough meat from the slaughter of

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starving horses and mules.

Defeat inevitable, MacArthur and other top brass were evacuated to the safety of Australia, while the Japanese continued to pound the Bataan peninsula.

In April, the Japanese ground troops moved down to take over. On the 8th, General Wainwright concentrated all his viable forces for a last-ditch effort on Corregidor, and on the 19th formally surrendered the starvelings left behind on Bataan.

The changeling had watched this all with interest. It had been killed twice by bombs, but in the chaos it was easy to reassemble at night and show up as a lucky survivor. It had mimicked the weight loss of the men around it, Jimmy going from a healthy 180 pounds to a haggard 120.

When they heard about the surrender, some of the men decided to chance it and try to swim across two miles of shark-infested water to Corregidor. The changeling could have done that with ease, of course, temporarily becoming one of the infesting sharks, but decided against it. Corregidor was doomed, too; why bother?

His friend Hugh, who had been with him since boot camp, told Jimmy that he was tempted to swim even though he knew he wouldn't make it; he couldn't swim two miles even if he were in good shape, and the water a placid swimming pool. "I got a feeling," he said, "that drowndin' ain't nothin' compared to what the fuckin' Japs are gonna do to us."

That would turn out to be true for almost everyone but the changeling. They were about to begin a forced march from Bataan to a concentration camp some two weeks away, under broiling sun without food or water. The orders that the Japanese had been given in Manila said "any American captive who is unable to continue marching all the way to the concentration camp should be put to death." And they might be the lucky ones.

The changeling and Hugh and a dozen others were in a communications shack when the Japanese came. Five young soldiers with bayoneted rifles crowded into the small room and started screaming. They got louder and angrier, and the changeling realized that they expected their captives to speak Japanese. What else didn't they know?

By gestures they got across the idea that the men were supposed to take off their clothes. One was too slow, and a soldier prodded him in the buttock with the bayonet, which caused an unusual amount of blood and hysterical laughter.

"Oh my God," Hugh whispered. "They're going to kill us all."

"Try to stay calm," the changeling said without opening its mouth. "They'll go after people who draw attention to themselves." As drill sergeants did.

They rummaged through the pile of clothing, and one of them found a Japanese coin. He held it up and started screaming at a man.

"That ain't mine," he said. "They told us to get rid of all that shit." A soldier behind him clubbed him with his rifle butt at the base of the skull, and he went down like a tree. The soldier clubbed him twice more, but stopped at a sharp command.

The one who seemed to be in charge screamed at the captives, repeatedly gesturing at their fallen comrade, who was bleeding from both ears and twitching. Then they left, as suddenly as they'd appeared.

A man kneeled by his friend and gently turned him over. Only the whites of his eyes showed. He drooled saliva and blood and something like water. "Cerebrospinal fluid," the changeling said.

"He gonna die?"

"It's very serious." The changeling sorted through the pile and found its fatigues and put them on. "Better get dressed," it said to the man holding his friend. "We want to all look the same to them."

"Jimmy's right," Hugh said, finding his

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own clothes. "They prob'ly gonna kill us all, but I ain't gonna go first."

While they were dressing, a new Japanese soldier stepped into the doorway. He had a clean uniform and no rifle. He pointed at the naked man on the floor. "Bury him," he said in English.

"He ain't dead," his friend protested.

"Oh." The officer unsnapped a holster and pulled out a Nambu pistol. He bent over and put the muzzle in the man's mouth and fired. The noise was loud in the small room. Blood and brains and chips of bone scattered across the concrete floor. "Bury him now." He holstered the pistol and walked out.

The man who had been holding his friend started after the officer. Two others tried to restrain him, but he broke free. At the door, though, he sagged and just stared out. "Bastards," he said. "Fucking Jap bastards."

19. Apia, Samoa—2020

Everything else having failed to impress the artifact, the NASA folks appealed to their opposite numbers in the American military.

For more than fifty years there had been an international agreement forbidding weapons of mass destruction in orbit. That didn't mean you couldn't build them on the Earth, of course, and wait for the law to change.

HESL, the High Energy Spalling Laser, was not technically a "weapon of mass destruction" anyhow. It was designed to vaporize a small target, like a tank or a ballistic missile or even a limo with the right person in it, from orbit. What kept it from being orbited, for the time being, was the powerful nuclear reactor that powered up its zap.

The machine had been designed to just fit inside the new space shuttle's cargo bay, which meant it was way too large for the protective shell around the artifact. It took six weeks to disassemble it and rebuild a structure large enough to house the weapon.

Inevitably, it caused some friction between Russ and Jan.

Russ sometimes reacted to stress by eating. He got to #7 a half-hour before their noon meeting, and while brewing tea orchestrated a huge sandwich. Ham and beef and salami slices alternating with goat and cheddar cheese, sliced pickle and tomato and lettuce. They were out of pickled beet slices; he put them on the list. One slice of bread was slathered with mustard and mayonnaise, the other with peanut butter. He compressed the thing down to manageable proportions and sliced it in two diagonally.

"You're not going to eat all that by yourself, are you?" Jan was watching from the door.

"I'm willing to share." He put half of it on another plate and carried both to the table.

"Want tea?" She poured two mugs and brought them over.

She inspected the sandwich carefully and removed the pickle. "We've modified the thing so the first shot will be a tenth of the normal minimum power." She sliced a corner off the sandwich and nibbled on it. "Peanut butter?"

"So that would be about a thousand megajoules?"

"More like one and a half times that. We tried it out on a big block of stone down at the quarry."

"I'm surprised I didn't hear the explosion," he said around bites. "Peanut butter's the healthiest part of the sandwich."

"The engineers took precautions. It was swaddled in a ton of some kind of protective cloth. I mean, it *is* a spalling laser."

"So it spalled impressively?"

She nodded. "Blew it to flinders. Then blew out a piece of the quarry wall behind it, two hundred meters away."

"How long did it go?"

"Half a microsecond burst, they said."

He shook his head. "It's too big a leap. That must be a thousand times the ener-

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gy flux we've brought to bear on the thing."

"About eight hundred, I think. But that laser didn't even warm it up." That was true; they'd tried a twenty-million-joule industrial laser on it, and the thermal sensors hadn't budged. The thing seemed to be an infinite heat sink.

"What if we destroy it?"

"I think we'll be lucky to get enough ablation for an absorption spectrum."

"And if you don't, you crank it up to full power?"

"Only by degrees. We'll be cautious, Russ."

"Oh, I know you will." He took a big bite and concentrated on chewing it. "I'm mainly . . . I'm just worried about the first shot. If that doesn't affect it, it can handle another factor of ten."

"You anthropomorphize it. Brave little space ship versus the monstrous military/industrial complex."

"You've been hanging around too much with Jack. Speaking of anthropomorphizing. He's angry with the thing."

"Well, it's resisting his advances." She looked at him steadily. "He doesn't like that."

Russ couldn't repress a smile. "He doesn't, eh?" Jack's attraction to the astrobiologist had been immediately obvious.

She rolled her eyes. "I'm a grandmother."

"But not very grandmotherly."

"Don't *you* start. I'm ten years older than you."

Nine, Russ thought, but didn't press it. "You want something besides the sandwich?"

"Pepcid. I brought my own."

20. Bataan, P. I.—28 March 1942

Thousands of American and Filipino captives were herded onto dusty fields outside of the town of Marivreles, and made to sit under the baking Sun without provision of food, water, or latrines.

The changeling and Hugh had each managed two canteens, and they had a loaf of hard bread between them. The other fifty-some Marines were someplace else in the vast sea of suffering men. Some units had stayed together, which proved a significant advantage for individuals' survival; others, like the Marine detachment, were broken up.

Hugh carved an inch-thick slice of the bread with his mess-kit spoon, and they split it. The changeling could have done without, of course, but couldn't think of a reason to refuse. He took the smaller half.

"God, I'd kill for a burger," Hugh said quietly, eating the bread in pinches of crumbly dry crust.

"People will kill for bread soon enough," the changeling said, "unless they decide to feed us."

"Kill for water," Hugh said, taking a small sip.

People did *die* from water, starting that day. Dehydrated, they would greedily lap or suck from any source, and every source that wasn't purified was contaminated. Dysentery increased the foulness of the camp, and further dehydrated the dying men. The Japanese opened a tap that gave a trickle of brown water to people who were strong enough to stand in line for hours. Hugh had a tin of iodine tablets that made the water safe to drink, though the taste made most people gag.

The changeling thought the iodine was a delicious condiment. Like the chlorine it had enjoyed in boot camp, iodine was a halogen, toxic to most Earth creatures.

When night fell, the Japanese soldiers moved through the horde of collapsed captives, yelling and kicking at them. The ones who were dead, or not alive enough to respond, were buried by the ones who were able to hack a hole in the hard ground with entrenching tools.

Some were buried prematurely. If they struggled, a guard would help them along with rifle butt or bayonet.

At dawn, they started pulling people at random, to form into marching ranks

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of forty to a hundred each. When he saw what they were doing, Hugh gave the changeling half the iodine tablets, folded into an old letter from home. That was a prescient as well as an altruistic act; minutes later they hauled him roughly away. They would not see each other again for a long time.

The changeling sat quietly for two more days, watching the crowd of strangers around it thin. From the lack of bread, it shrank imperceptibly, and tried to mimic the symptoms of starvation, to keep from standing out.

On the third morning, two soldiers hauled the changeling to its feet and pushed it to the road. It joined a motley crowd of army and navy men, some asleep on their feet, a couple being held up by others.

A Japanese yelled something like "March!" They straggled forward. Someone started to call cadence, but several others advised him to shut the fuck up.

At first they stayed in a fairly coherent group, but as the Sun grew higher, the worst off began to fall back. The road was rough, torn up by tank treads and occasional torrential rains, and even a person who was totally in control of his faculties would find it difficult to maintain a forced-march speed.

The only person in total control of its faculties was not even a person.

The Japanese hounded the stragglers, whipping them with ropes and punching them with gunbutts, and prodding with bayonets the ones who still lagged behind. At first it was shallow jabs to the buttocks and back. After awhile they jabbed harder, and the ones who fell and couldn't proceed were shot where they lay.

All the time the soldiers kept up an indignant tirade against their captives. The changeling wondered whether they were actually so unworldly and ignorant as to suppose that everyone spoke their language. It began to work out a basic vocabulary, at least of imperative commands. It could see that there might come a time, soon, when it would be practical to change form for a while; become Japanese.

For several days there was little variety, except when the blistering heat was punctuated by torrential downpour. That would leave rapidly shrinking mud puddles from which people could try to fill canteens, or just fall to the ground and lap, if the guards allowed it.

The changeling had altered its metabolism to do without food and water. It imitated the bone-weary stagger of the men around it, but still had its normal strength, which led to its murder.

A Japanese truck—a Chevrolet—full of soldiers rumbled by, and one of them did a trick he evidently had been practicing. He dropped a lasso around one of the marchers, intending to drag him along. But he chose the man who was next to the changeling. Crashing to his knees, he cried out, and the changeling automatically snatched at the rope and gave it a jerk, which pulled the Japanese cowboy suddenly off the truck. He hit the ground hard, and the others on the truck started yelling.

Everybody stopped for a few seconds while the soldiers checked their fallen cowboy comrade, whose face was a flag of blood when he shakily stood up. He pointed at the changeling and shouted, gesticulating.

An officer walked back to where it was standing. He was marginally neater and cleaner than the others, and carried a sword of rank.

He looked at the changeling's face for a long time, and said a few quiet words. Then he turned on his heel and walked off the road. Two guards took the changeling by the arms and followed. Others began yelling at the standing crowd, trying to get them moving again. There was some shouting from the Americans, but a rifle shot silenced them, and the changeling could hear the crowd shuffling on.

When they'd taken it a couple of hundred meters, they stopped, and one of

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the guards threw a shovel at the changeling's feet. "You must dig your grave," the officer said.

This was interesting. "No," the changeling said to him. "Make the one with the rope dig it."

The officer laughed, and said something in Japanese. The guards laughed, too, but then there was an awkward silence, and the officer whispered two syllables. The one with the bloody face began to dig, obviously stiff with pain. They tied the changeling's hands together.

It was a shallow grave, little more than a foot deep, and barely long enough for its six-foot frame.

"Kneel," the officer said, and someone kicked the changeling behind the knee. It heard the blade swishing down and felt a hard blow at the base of its neck, not as painful as changing its body, and then another blow.

The world spun around, sky twice. The changeling's head came to ground face up, and it watched with interest as its upside-down body spouted blood, and then fell or was pushed into the grave. It couldn't see after that, but heard and felt the warm dusty soil being shoveled over it. ■

TO BE CONTINUED

Parkinson's Law:

Work expands so as to fill the time available for its completion.

—C. Northcote Parkinson

Throop's Corollary:

To keep work from expanding to fill all your time, you must strictly limit the time available for its completion.

—Kelvin Throop

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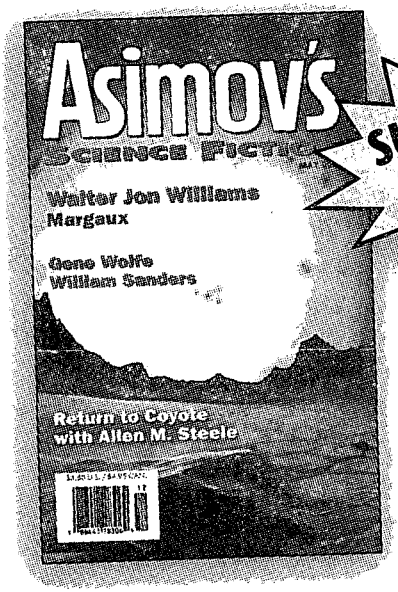

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ARTIFICIAL CHROMOSOMES

For Gene Therapy and Designer Babies

Kyle Kirkland

Everybody's got a bad gene or two, and most people probably have quite a few more. If you're lucky, you don't know about them.

If you're unlucky, then perhaps you're already painfully aware of at least one of these bad genes. Single gene defects are known to cause several thousand different diseases, such as cystic fibrosis, sickle cell anemia, and hemophilia.

But bad genes aren't always so obvious. Sometimes genes merely predispose you to a certain illness. Somehow they make you more susceptible. For example, there are genes which greatly increase your chances of getting certain types of cancer; in most cases these genes probably don't cause the disease, they simply put you at greater risk than other people.

And then there are genes which are not really bad, per se, but still not quite as good as you'd like them to be. Perhaps you've always wanted to become Mr. (or Ms.) Olympia, but no matter how often you hit the gym you can't seem to develop spectacularly large muscles. After a great deal of effort and frustration, you subsequently discover that genetics has a strong influence in just how much muscle mass you can realistically hope to obtain—and, it seems, unlike Arnold Schwarzenegger, *your* genes leave a lot to be desired. Thus your genetic inheritance sets a restrictive upper limit, and you wistfully reflect on the fact that your ancestors were—oh, go ahead and say it!—a bunch of wimps.

I'm afraid that this was pretty much my own situation when I was a young man, struggling to build muscles. There are, of course, ways of getting around the problem: you can take massive and dangerous doses of steroids. Or you can find an alternative outlet for your energy, and devote yourself to other goals. For instance, you can become an immensely knowledgeable and incredibly handsome scientist, which is what I did.

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But wouldn't it be fantastic if we could change those wimp genes at will? Or even better: what if we'd been born with an absolutely perfect set of genes in the first place?

You've probably heard about a technology called gene therapy. (See, for example, "You Can Change Your Genes," by Catherine Shaffer, *Analog*, September 2003.) It's been researched for a number of years now, and scientists were seriously discussing the notion all the way back in the 1960s. But there are many difficulties. Getting a gene—which is basically a piece of DNA—to go into a cell and work like it normally would isn't easy. In some cases it's hazardous to even try it.

Now, however, there's a new concept on the horizon. It's based on the well-known fact that genes typically reside on a chromosome. So, instead of focusing only on genes, a few scientists have turned their attention to chromosomes. Would it be any easier, they wonder, to engineer and employ chromosomes instead of isolated genes?

At first glance it doesn't seem likely. The cells in your body have 23 pairs of chromosomes, and both members of a pair contain the same genes, although in some cases the corresponding genes come in slightly different versions. (An exception to the pairing rule occurs in males, since their "sex" chromosome pair is made up of entirely different chromosomes, an X and a Y.) Thus, there are 46 chromosomes, and human cells are finicky about that number. Generally it's extremely unhealthy to have 45 or 47. Down's syndrome is an unfortunately common example of a disease caused by an unusual number of chromosomes. (Another name for this disease is trisomy 21, since it's caused by having three copies of chromosome 21 instead of the usual two). Having extra copies of the X or Y sex chromosomes isn't usually so devastating, but for most of the other chromosomes it can be quite deadly.

However, cells might just be able to accommodate extra chromosomes, provided these "artificial" versions are appropriately constructed. And this may just be the thing that gene therapy needs in order to work out some of its problems.

But that's not all. A few bold thinkers have realized that artificial chromosomes, if successful, would be ideal not only to modify our own genetic repertoire but that of our children as well. Designer babies might be on the way—and soon. To me that's the most amazing thing of all: I can think of *nothing* that has more potential to drastically change us and our way of life than that.

The Trials and Tribulations of Gene Therapy

The motivation for gene therapy originally had nothing to do with designer babies. Generally, it still doesn't. The most common goals right now for gene therapy are far more pedestrian. Most of the current research involves the replacement of a single faulty gene, usually in a specific organ or tissue, and you wouldn't necessarily think that artificial chromosomes would be very useful. Why can't you just stick a gene where you want and be done with it?

The problem is that the exterior surface of a cell is a membrane composed mostly of lipids (fats) along with some protein, and it doesn't let stray DNA from the outside cross over to the cell's interior. Cells of humans (and other multi-cellular creatures) keep most of their DNA squirreled away in the nucleus (which, by the way, is a part of the cell that's surrounded by yet another membrane). Bits and pieces of loose DNA aren't welcome. In fact there are enzymes in the body that love to shred up DNA if it happens to be just wandering around, instead of sitting in the nucleus where it belongs. Stray DNA is bad news, possibly indicating the presence of an archenemy: a virus.

Not that you can't force a little bit of

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DNA into cells; you can do it if you use a little coercion. One way is to attach the DNA to tiny particles and shoot it in with a "gene gun." Or you can sneak it in by transiently disrupting the cell's membrane with an electric shock. Scientists have long been doing these things to cells in a dish. Unfortunately it works in an extremely low percentage of cells, and some cells are killed in the process. With few exceptions, it's not the method of choice when the cells you want to affect are in a person rather than in a dish.

You can also get DNA into cells by enclosing the DNA in a membrane of its own. But a better way of getting a gene into a cell is to make use of its archenemy. Many gene therapy techniques today employ a virus of some kind to do the dirty work.

A virus is simply a small piece of nucleic acid, either DNA or RNA, which contains a small number of genes, all encased in a protein coat. And that's it, that's all there is; viruses have no metabolism and they can't do anything without first invading a cell and taking over its machinery. Of primary importance is replication, and viruses have evolved some mighty sneaky ways to trick cells into making copies of their genes.

The advantage of using viruses in gene therapy is clear. If you're trying to get a gene into a cell—say, to take over the job of a faulty version of that gene—you can do no better than to hire a virus. They've been doing the job for a long time.

The disadvantages are also clear. Viruses are dangerous. The principal mission of their genes is to pirate a cell's metabolic processes, which allows the virus to make more copies of itself. Obviously researchers who use viruses for gene therapy rip most of these genes out (replacing them with the gene they wish to insert into the cell), but it's still a little worrisome. And there's always the danger that a virus, even a gutted one, will activate a severe immune response.

The worst part of the whole thing is that even with the help of castrated viruses, gene therapy has for the most part been strikingly unsuccessful. Hundreds of clinical trials for gene therapy since the early 1990s have resulted in very little except for hundreds of humbling failures. It's been a very depressing beginning for a technology that promised so many great things—and *seemed* like it should be so easy to do. One of the darkest moments came in 1999, when a patient in a clinical trial died as a direct result of the treatment.

Thus far the only real success came a few years ago, when it was reported that gene therapy cured a few very young patients with "bubble boy" disease (Cavazzana-Calvo *et al.*, 2000). (Children with this disease are born with a severely deficient immune system and must live in an isolated chamber in order to avoid infection.) But in late 2002, this widely lauded success was dimmed when it became known that at least two of the patients have subsequently contracted leukemia.

And here we come to the crux of the matter. To fix a genetic mistake you often need to do it permanently; in other words, you need to get the good gene into the cells and have it stay there. It's not *always* necessary to do this; sometimes transient expression is sufficient. But when permanent placement is needed, the best way to go about it is to get the gene integrated into the cell's normal complement of DNA. If it's not—if the gene is simply floating around in the nucleus, instead of getting inserted into a chromosome—then it typically stops working after a while, which means you've got to give the patient another dose of virus. Repeatedly doing this tends to have bad effects and invites a potentially hazardous immune reaction.

So you often want to stitch the gene into one of the target cell's chromosomes. Are there any viruses that will do that? Indeed there are—as many unfortunate people know all too well. Viruses

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called retroviruses will do the job. They're particularly nasty little bugs which are hard to shake, since they insert their genes right into the infected cell's own DNA. HIV, the virus that causes AIDS, is a notorious example.

But if you want a permanent fix, you usually need to stably integrate the gene into a chromosome. Obviously the nasty genes of the retrovirus are replaced with the therapeutic one, but there's a downside—and it's a big one. Retroviruses don't care too much *where* in the cell's genome they stick a gene. That could have disastrous consequences. It could be inserted in the middle of another gene, for example. Even if the added gene doesn't land in the middle of any good genes, it might adversely affect the function of ones nearby.

The danger of random insertion has been recently highlighted because researchers believe it's responsible for the leukemia contracted by those two otherwise successfully treated patients (Kaiser, 2003). It appears that in a few cells, a retrovirus shoved the therapeutic gene in a very awkward place, and these cells began to divide uncontrollably. That's how a cancer like leukemia starts.

It's a definite setback for gene therapy. However, in my opinion it's not bad enough to stop ongoing research—at least not for long. After all, it *did* work, and the patients who were successfully treated—nine as of early 2003—would have died otherwise. (And hopefully the leukemia sufferers will respond to treatment.) Gene therapy continues to have a lot of promise.

But it does give pause for thought. Is there a better way of getting a gene permanently into a cell?

Artificial Chromosomes

If you can't control where the added gene ends up, you'd prefer to not insert it into a chromosome because it will probably be randomly placed. But for permanence and stability you *do* want the gene in a chromosome. Which gives rise to the idea of artificial chromosomes.

It's not as outlandish as it sounds. Different species have different numbers of chromosomes; we have 46, mice have 40, chimps have 48. There's no inviolable rule that dictates how many a cell must have. It's usually unhealthy to have extra copies of a chromosome, but that's not necessarily true for having a copy or two of a novel one.

Although a chromosome is basically just a long piece of DNA, constructing one is hard work. Some researchers don't even try it: the artificial chromosomes they use are stripped-down versions of an existing chromosome. (Some people call this an "engineered" chromosome rather than an "artificial" one.) But a few labs have been successful in building one from scratch too.

A viable chromosome generally needs three things. It needs certain DNA sequences that help it to replicate. It needs something called a centromere, which is crucial during cell division. And it needs sequences called telomeres at both ends. All of these requirements are essentially due to the intricacies of replication.

A cell replicates itself by dividing into two roughly identical twins. This happens a lot in a young, developing animal, but it also happens quite often in adults. Since cells have two copies of each chromosome, it's obvious that a cell that's about to divide must make an extra two copies of its chromosomes. (This doesn't apply to sex cells when they divide to become sperm or eggs, which only have a single copy of each chromosome.) Furthermore, the cell needs some way of segregating the chromosomes so that each daughter cell ends up with two of each, not four of one and zero of another.

Thus, before a cell divides, it has double the usual number of chromosomes—two pair of each, not just a single pair. The chromosomes line up in an

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orderly arrangement, and little filaments become attached to each pair of chromosomes. There are two sets of filaments, one at each end of the dividing cell, and each set pulls one and *only* one pair of every chromosome toward its end. Thus after division both daughter cells each have a single pair of every chromosome. The part of the chromosome to which the filaments attach is the centromere.

The whole process of cell division, including the details of the centromere, remains mysterious. Until we have a better understanding of this amazingly complicated process, making centromeres—and hence artificial chromosomes—will be a little bit of a hocus-pocus type of thing. (In contrast, the task of adding telomeres, important though they are, isn't difficult. In a sense, telomeres are just padding at the end of a chromosome. And if you construct a circular artificial chromosome, you don't really need them.)

There's also the problem of getting the artificial chromosome into a cell. It's the same problem as with a gene, magnified several times: now we're dealing with a piece of DNA that's a lot bigger. Most viruses can't help; viruses are streamlined, and artificial chromosomes—even tiny ones—are often so big that you can't cram one into a virus. Most researchers transfer an artificial chromosome into cells by enclosing it in a membrane, which can fuse with the target cell's membrane. This process is readily doable, but it's far easier when you have control over the cellular environment. (In other words, it's much easier to do it to cells in a dish rather than to cells that are currently inhabiting a body).

However, no matter how difficult an artificial chromosome is to construct and insert, once you finally make one and get it into a cell's nucleus, it can do its job. If you supply it with genes and the necessary promoter sequences (so that the cell will read out or "express" the genes), it can work just like a natural chromosome. This has been done for more than two decades in yeast—which, by the way, have genetic processes that are fundamentally quite similar to ours. It's not just some arcane academic exercise, either. Scientists have found it extremely useful to slip additional chromosomes into yeast cells. By letting the cells express a certain gene over and over, you can produce a ton of a specific protein. Or by simply allowing the cells to replicate time and time again, you can make a lot of copies of any piece of DNA. (The Human Genome Project made heavy use of this technique, since it takes a large number of exact copies of a DNA molecule before you can determine the sequence.)

It doesn't just work for lowly yeast, either. After a lot of diligent research, scientists have been able to add artificial chromosomes to human cells (in a dish) (Willard, 2000; Larin and Mejía, 2002). The chromosomes seem to work: a gene residing in the chromosome can be expressed, and, just as importantly, the chromosome is stable—a dividing cell is usually able to pass it along to daughter cells. The artificial chromosome has evidently become accepted as one more member of the cell's chromosomal family.

It's one way, and in many circumstances perhaps the best way, of permanently altering a cell's genetic repertoire. It neatly solves the problem of random insertion, and theoretically there's practically no limit to the size and number of genes you can add.

However, there's still the unfortunate problem of getting the thing in the cell. Furthermore, sometimes when you add a corrected gene to a cell it doesn't do any good unless you silence the faulty gene that it's meant to replace. But these are also issues with all types of gene therapy. If these issues can be addressed—and I suspect that in at least some cases they will be—artificial chromosomes have a bright future in gene

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therapy.

And possibly quite more.

When gene therapy is discussed these days, it almost always refers to *somatic* cells. A cell is called somatic if it's *not* one of the sex cells, also known as "germ" cells—sperm and eggs. It is generally considered ethical and appropriate to conduct somatic-cell gene therapy, meaning that there's nothing wrong with altering the genetic make-up of one of your liver cells or skin cells or even brain cells. But it's a different story with germ cells. Many people have serious concerns about germ-cell gene therapy: altering germ cell genes means that not only the patient will be changed, so will his or her children. Researchers involved in gene therapy trials with human patients generally go to great lengths to avoid the possibility of inherited genetic modification. This has been true ever since gene therapy first began to be discussed; up until a few years ago there are scarcely any references to germ-cell gene therapy in the scientific literature, except to say "we shouldn't do that."

That's beginning to change now. An article on the topic, entitled "Biology's Last Taboo," appeared a few years ago in the prestigious journal *Nature* (Knight, 2001). People are starting to at least think about it. And it hasn't escaped notice that an excellent tool to use in germ-cell gene therapy just happens to be artificial chromosomes.

Designer Babies

I suspect that some *Analog* readers will find the squeamishness over germ-cell gene therapy a bit curious. We as science fiction readers are used to new ideas and are probably more comfortable than other people with the notion of technological change. We might ask, what's wrong with germ-cell gene therapy? It seems like a pretty good idea to correct a faulty gene not only in a patient but, while we're at it, in his future kids too. And if people use it as a way of enhancing their children, so what's the big deal?

Yet to many people the very idea is horrifying. Germ-cell gene modification invokes images of Nazi eugenics, or nightmarish scenarios where humans are nothing but assembly-line toys. Critics almost invariably use the term "brave new world," which refers to Aldous Huxley's famous 1932 novel.

Many science fiction fans have read Huxley's book. A lot of us have also read another book that was first published about the same time as Huxley's: Olaf Stapleton's *Last and First Men*, which chronicles a much different and more optimistic scenario of how humans might change themselves. Most of us who are open to the concept of change realize that there can be both good and bad associated with it.

A few outspoken scientists feel more or less the same way. Gregory Stock, at the University of California, Los Angeles, has organized seminars and written articles arguing that germ-cell genetic modifications won't necessarily be bad—and can be quite beneficial. In his much-discussed book, *Redesigning Humans: Our Inevitable Genetic Future*, Stock claims that inheritable genetic modifications are an inevitable and potentially healthy consequence of our technological progress. It's an excellent book—both thoughtful *and* easy to understand -- and if you're interested in this subject, you would do very well to visit your local library or treat yourself to a copy.

That doesn't mean I agree with everything Stock says. But I'll get to that in a moment.

Stock's vision concerning the future of artificial chromosomes is quite interesting. He sees them developing in a similar fashion to software programs; early versions will be primitive, containing perhaps only a few genes. Later, more developed (and hopefully bug-tested) versions will give you an added selection of features to choose from: the latest genes for a long and healthy life,

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perhaps; or ones that will allow a greater athletic endurance.

And how will people manage to get artificial chromosomes inserted into their children's cells? And what happens if something goes wrong?

Insertion isn't all that much of a problem—provided you're comfortable with and can afford a treatment procedure called in vitro fertilization (IVF). Did you know that the first test-tube baby was born (with much fanfare) all the way back in 1978? Well, she's still doing fine, and she's got lots of company: IVF has helped hundreds of thousands of couples conceive. Although it's expensive and it doesn't always work, many otherwise infertile couples evidently feel it's worth it.

The procedure goes like this: egg cells are removed from the woman—a rather delicate procedure, by the way—and placed in the dish. The man's contribution—which is *far* more easily procured, and only requires that he do something which would merely prove embarrassing if he had an audience—is mixed in. Thus the egg becomes fertilized in the dish ("in vitro") rather than in the normal way. The fertilized cell is generally allowed to divide a few times and the tiny embryo is implanted in the woman's uterus.

But wait a minute. Before you do the implantation, why couldn't you change a few bits here and there? As long as you've got the fertilized cell conveniently sitting in a dish, why not? It wouldn't be too difficult to add an artificial chromosome or two at this point, and if you do—and providing it's stable—then all cells of the child will have it.

What's more, it can be designed to be reversible. It can even be dormant, activated only at certain times and by certain methods, such as by giving the person a specific drug. These things are done all the time in animals. And it's been proven that artificial chromosomes will work: scientists have inserted an artificial chromosome in mice and shown that it can be passed along to the next generation (Co *et al.*, 2000).

There's no reason these things won't work in humans too. But you can also design the artificial chromosome so that it doesn't exist in the treated person's germ cells; that way the modifications won't get passed along except if the person wishes to do the in vitro procedure with their own children. (If so, it would probably be with a newer, more up-to-date version anyway.) That would also avoid ticklish issues about who can mate with whom, since viable offspring would probably need matching artificial chromosomes.

Manipulating—or at least testing—human embryos in a dish isn't exactly new. A procedure called preimplantation diagnosis has been done for years. Sometimes couples who opt for IVF wish to have the embryos screened, usually to detect genetic diseases for which one or both of the couples believe they might carry. Implantation is done only with an embryo that has a healthy version of the tested gene. This is perfectly acceptable and permissible in most places. Besides, private clinics in the United States are currently not strongly regulated.

Gregory Stock argues that germ-cell genetic modifications will necessarily emerge from these current technologies. He thinks that with careful (though not oppressive) oversight, such tinkering with evolution—playing God, as it were—won't turn into a eugenics nightmare. Besides, Stock is convinced that it's bound to happen: people will want this because we all want to give our kids an advantage, to provide the best we can for them. In the future, conception might *always* take place in a dish; sex will be for cheap thrills only.

Sound good? Or perhaps you're one of the ones who find it repulsive. Playing God, indeed. Are we smart enough to direct our own evolution?

Think about H.G. Wells' novel, *The Time Machine*, and his vision of the separation of humans into two very differ-

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ent races. If that appears wildly improbable, consider the difference between a Chihuahua and a Great Dane. There can be tremendous effects when you tinker with genes. The genetic difference between you and a chimpanzee is *only a paltry few percent* of your DNA.

Stock believes that drastic changes in our shape and abilities are highly unlikely, at least in the near term. In the beginning, he says, artificial chromosomes will rely on tried-and-tested genes; in other words, parents will select a version that contains the genes of successful people, or genes that are known to confer specific benefits. For example, a small but lucky percentage of the population is highly resistant to AIDS. If you can identify the responsible gene or genes, that'd be worth having.

There are other things, of course, that are much more dubious. I can see the ads now: Shopping for an artificial chromosome? Try Football Superstar ™! Contains the genes common to every Super Bowl MVP in the last three years! (And then the fine print: your child's mileage may vary.)

Ah, the fine print. It might not work for your kid. It's true: for most of the complex traits—like being a great football player—genes aren't the only determining factor. Genes merely produce tendencies.

But even if germ-cell gene mods can't always produce a superstar athlete or talented musician—or even an immensely knowledgeable and incredibly handsome scientist—that doesn't mean they won't often be tried. As a consequence, genetic diversity may be reduced. This is one of the greatest fears of people who worry about us directing our own evolution.

What if we delete a "bad" gene that just happened to have some potentially good properties? The classic example is the gene for sickle cell anemia; if present in both copies, the person gets the disease, but if present on only a single chromosome of the pair, it provides some protection against malaria. The danger is that we might eliminate a gene that might have protected some of us from some future plague.

I don't buy that argument, because it can just as easily happen that one of the deleted genes would have made us *more* susceptible to a future plague. What I do realize, however, is that a reduction in genetic diversity can have bad consequences regarding the *spread* of diseases. Suppose that a certain gene makes a person highly susceptible to a specific contagious disease; then to some extent genetic diversity protects the population. Contagions need carriers, and there might be only a few potential victims nearby, because the susceptible gene is present in few other people. So the disease dies out before it can spread and become a plague. However, if all or most of us have this gene, potential carriers abound; in that case the victims must be physically quarantined—but that might not happen before it's too late. We'd all fall like dominoes.

So there are trade-offs here, as in all things.

The one thing that bothers me most, however, has little to do with genes. It's psychological: the placebo effect.

It's well known that patients who *expect* to recover have a better chance of doing so than ones who don't. What we believe will happen has an important effect on what actually does happen. So what if it turns out that artificial chromosomes don't really do much of anything (for complex traits)—but people *believe* that they do?

Would it matter? Consider a child who knows he's got the genes of superstar athletes. Let's say that he received the latest, specially designed (and frightfully expensive) artificial chromosome. Will he try harder because of it? Practice more? Be more enthusiastic? *Expect* more of himself than, say, a kid who doesn't have a genetic "advantage"?

If "designer babies" ever come about,

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there's no doubt that humans, and human society, will be drastically changed. I can well understand why some people are against it.

But I'm afraid I have to agree with Gregory Stock on one important thing. If it's technologically feasible—and there's every indication that it will be—then germ-cell genetic modification will happen. Forget trying to ban it. Ever try holding back the ocean with a broom?

Even though there are pitfalls—and I'm far from convinced that people will use the technology wisely—I suspect that our descendants will be glad it came about. In the past, people have certainly had to endure some pretty harsh and disruptive changes which at the time they probably would have just as soon foregone. The Industrial Revolution is one such: it caused a number of unpleasant adjustments in people's lives, and it had a definite downside in the form of pollution and other environmental ills. But I, for one, am plenty happy with at least *some* of the results: air conditioning, refrigeration, and a thousand other things that we take for granted today.

Perhaps one day in the distant future a human—though he or she or it may not go by that designation—will sit (or levitate or bounce) and scratch a puzzled brow (or dome or carapace) with a finger (or tentacle or some such convenient appendage), and wonder how primitive people like us ever managed to survive.

I take some small degree of comfort in believing that I'll at least have *something* in common with this future creature. Every weekday, as I observe the confusion and noise and crowding of a Philadelphia rush hour, I, too, wonder how we manage to survive. ■

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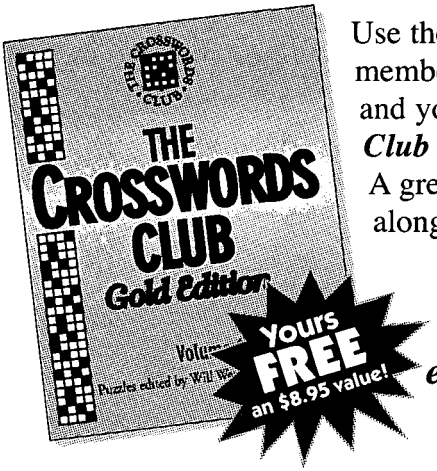

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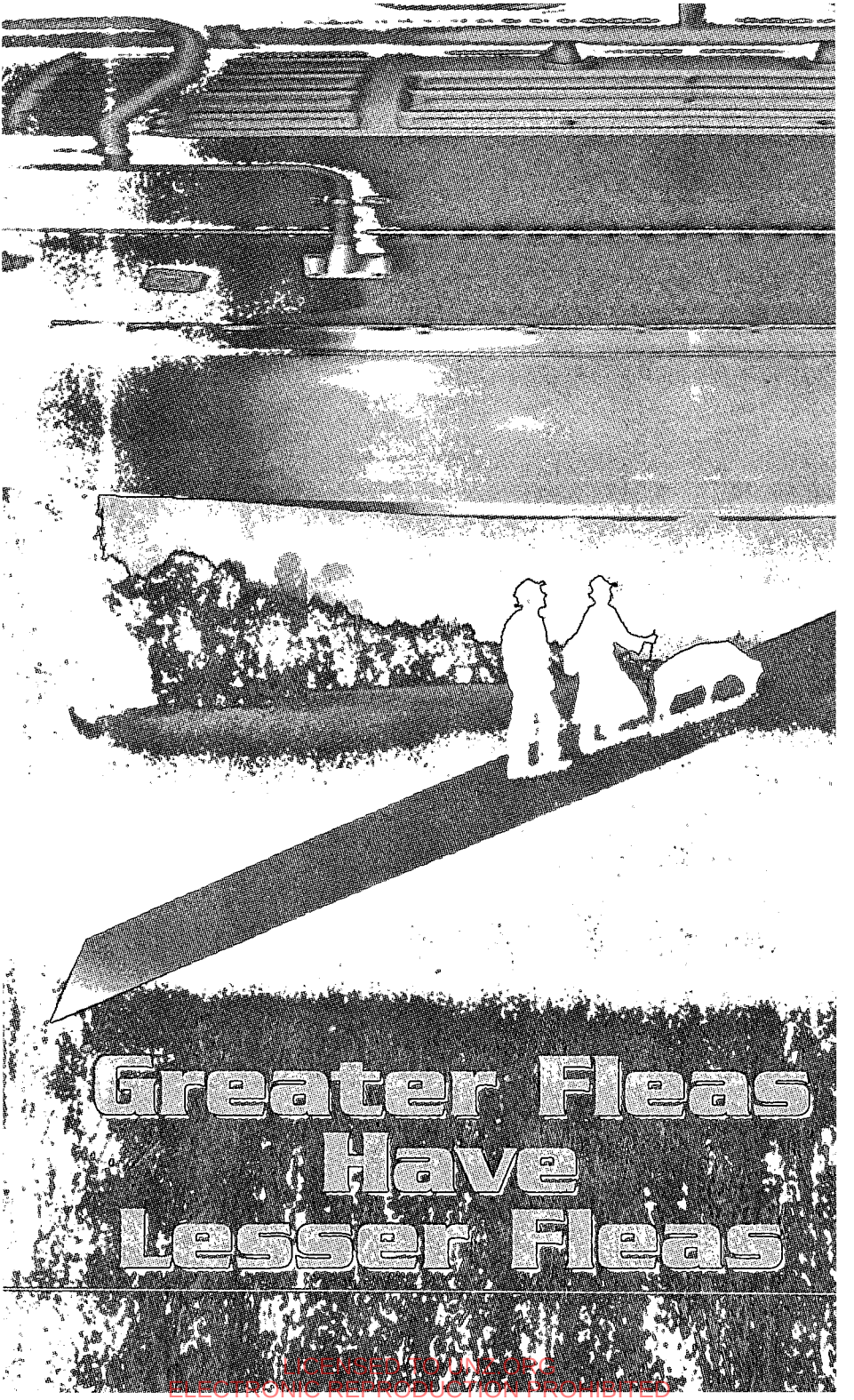

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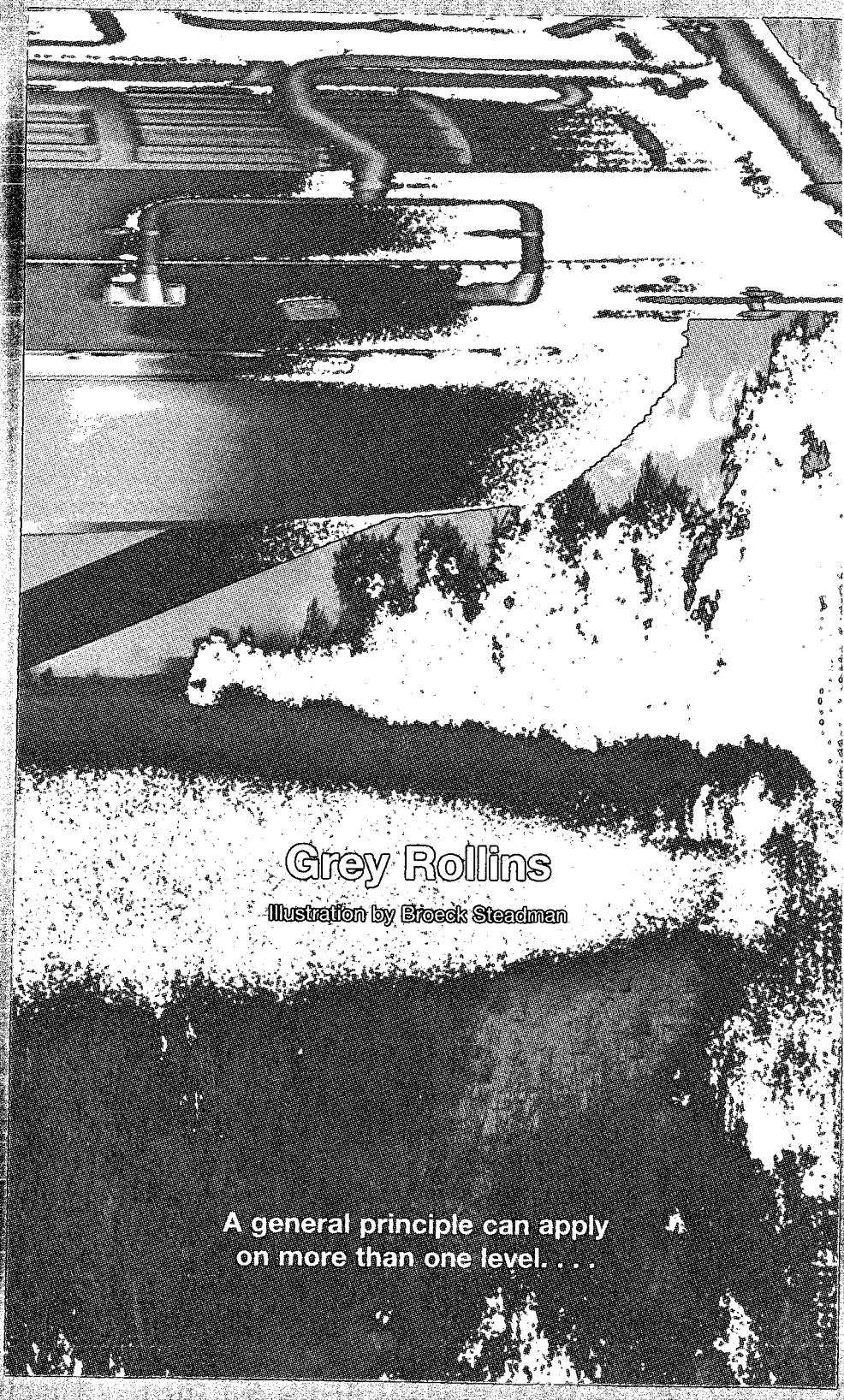

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All Liam O'Malley wanted was to be a farmer. His family had been farmers for as long as anyone could remember, and he had grown up secure in the knowledge that it was what he, too, would do when the time came. He loved the feel of the soil and the way it smelled just after it began to rain. The waving, vibrant green of growing things in a strong breeze was beauty incarnate to him.

Liam O'Malley could no longer farm. He'd been denied the permits he needed to get fertilizer, seed, and irrigation water for three years running. Without them, he was a farmer in name only. He sat and watched his fields waiting for spring plantings that never came; for fall harvests that never happened. When the cumulative weight of his bills became too much, he put his farm up for sale. He was not surprised when it was bought by Max-Agra. They already owned 68 percent of the arable land in the county. They had permits. It was loudly whispered that they had a cadre of politicians in their pocket, and could get anything they wanted. The official story was that they were able to use water and fertilizer more efficiently than small, independent farms. In reality, they were far more wasteful than any independent farmer in Hobson County had ever been.

Unlike many others in his position, Liam O'Malley wasn't bitter or angry. He'd seen the future coming, done his best to prepare for it, then been quietly philosophical when he'd lost the game. Still, he wanted to farm. So he methodically set about looking for a place where he could do so without being shouldered aside by bureaucrats and large corporations. Sadly, the United States were out of the question. There was no place he could go and feel that he had a good chance of remaining unmolested for as long as ten years. Small, family-sized plots weren't a threat, but anything over a few acres would not escape notice for long. He wanted something he could hand down to his children, not a short-term hobby farm.

He looked at other countries. Africa, in particular, needed farmers badly. As always, people were starving there but, as always, the region was infested with unstable governments and corruption. Central and South America were in much the same condition. Asia was in such a state of hostility that war could break out at any moment. Australia was not only in the grip of a long term drought, but showed every sign of going the same way the United States were going. Europe was highly regulated, and the best land had long since been taken.

That left Organala.

The Siltook had arrived in the solar system twelve years earlier. They had sent robot probes before committing themselves to a face-to-face meeting. It was a good thing they did. Out of eleven robot ships, two were shot out of the sky as they maneuvered in for landings. One was attempting to land in Israel. The other was destroyed over the Pacific by North Korean fighters. Of the remaining nine, two suffered attacks from small arms fire once on the ground. Nervous citizens outside São Paulo, Brazil took cover behind a car and peppered one of the robots with pistol shots until they ran out of ammunition. In Illinois, an irate hunter took careful aim at what he thought might be a porthole and squeezed off a shot. He was angry that the descending ship had spooked a deer he'd been stalking. The Siltook probe ships made no attempt to defend themselves.

When the Siltook themselves arrived three months later, it was almost anticlimactic. The question of whether humans were alone in the Universe had already been answered. People, although wary, were not surprised when more ships arrived. Only six this time. They did not land on the White House lawn. They did not land in front of 10 Downing Street. They did not land in front of

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the Imperial Palace in Tokyo. They landed in quiet places. The only one to land in the United States chose a pasture in Kentucky. By the time the local police arrived, the horses had gone back to grazing placidly, lending an eerie contrast between rural Americana and unknown alien intentions.

The intentions were soon found to be peaceful enough. The Siltook were open to trade, offering technology and odd foods from other worlds in return for woods which they regarded as exotic, such as ordinary white pine, blown glass art, and fish. Fresh basil was also high on their list of trade items, once it was discovered to be compatible with their physiology.

Their ships were obviously more advanced than anything human technology could produce, but humans had managed more in medicine and chemistry, particularly plastics. Regular trade began within the first year, with a quartet of spherical freighters making the trip between Organala and Earth in about three days.

It didn't take long before humans were clamoring to visit Organala, but the Siltook were not interested in tourism. From the images they'd shown of Organala, it was a beautiful planet, but any suggestion of human visitation was ignored. Whenever the idea was brought up in negotiations, they politely steered the conversation in another direction.

Chuck Wilson was the first person to attempt to stow away on a Siltook ship. He died in the attempt. He had scrambled up a ramp into a hold that turned out not to be pressurized during the trip back to Organala. The Siltook returned his remains without comment. The fields where the Siltook landed acquired fences and guards. But fences could be breached, and the guards, being human, could be bribed. Attempts to hitch a ride soon resumed.

Whereas Chuck Wilson had been thrill-seeking, it wasn't long before dispossessed farmers began trying their hands at making the trip, and they were in deadly earnest. They went at it systematically, eventually succeeding. A few hardy souls traveled both ways; the beginnings of an underground railroad.

Liam O'Malley pinned a picture of a wide prairie on Organala on the wall and sat brooding on the possibilities. He had no living relatives, and his wife had only one distant cousin whom she had not spoken to in twenty years. There were friends, of course, but none they felt truly close to. In short, there was only the love of the area they'd grown up in to hold them back, but as much as he wanted to stay, things had changed beyond all recognition, and there appeared to be no turning back. Slowly, inexorably, the industrial revolution was rolling over the agricultural belt.

Finally, after one last look at the unattractive possibilities that Earth offered, he talked it over with Gwendolyn, his wife. She was fearful, but willing, so they set about making plans and accumulating the belongings they would need on Organala. Fortunately, seeds are small, cheap, and lightweight. Clothes and food to eat while they were getting their first crops in the ground, however, were bulky, heavy and comparatively expensive. Farm implements and a few simple tools would be even heavier still. Unfortunately, all of it would be irreplaceable once they were away from Earth and they would be forced to travel heavy.

In a motel room not far from the nearest Siltook landing field, Liam and Gwendolyn were stuffing their belongings into backpacks when they heard a light tapping at the door of their motel room. Gwendolyn answered the door and found a young woman standing there in a denim jacket that had seen better days. For that matter, the woman herself looked as though she'd been through some rough times.

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She craned her neck, peering past Gwendolyn at the seed packets arrayed on the bed. "Mind if I come in?" Without waiting for a reply, she slid sideways into the room, approached the bed, and began surveying the neat rows of seed packets critically, her hands rammed deep into the pockets of her jacket.

Liam looked up at her, his face a mixture of confusion and irritation. "No one said you could barge in here," he said.

The woman leaned down and tapped the Golden Bantam corn. "Plenty of that where you're going. Silver Queen, too. My advice would be to take something else—something other than corn, for that matter. Corn takes too much fertilizer and water. Go for something that takes less maintenance. You won't be able to go out and buy fertilizer—the soil is good, but not *that* good. You'll tire it out if you start planting something that takes so much in nutrients. Besides, if you decide you still want corn after you get there, you can trade for an ear or two with someone else."

Liam's eyes narrowed. "Just who the hell are you, and what makes you think you know where we're going?"

The woman grinned at him. "My name's Tina Cartwright, and I'm going to help you get to Organala in one piece."

Gwendolyn inhaled sharply. "We're not going to Organala!" she protested.

Tina snorted. "Sure you are. Just think of me as a guide."

"But—" Gwendolyn began.

The other woman waved her off contemptuously. "Oh, be quiet, honey. Save your breath. We've got a lot of planning to do. It'll be easier on everyone if you'll just trust me."

Gwendolyn was getting angry, but Liam was growing more curious as his innate pragmatism came into play. "So what's in it for you?" he asked.

"Money," Tina said distractedly, still prodding through their seeds. "Lots of lovely, green money. Hmmm . . . cucumbers . . . not a bad idea. I don't think anyone has done cucumbers yet. *Ahh*, peppers! That's good thinking. Herbs and spices are a real good bet. Everyone keeps thinking in terms of stuff to put on the table, but they forget that food gets boring fast if you can't spice it up." She swept a space on the bed clear and sat, propping her elbows on her knees, hands clasped. "Look, as a general strategy, you'll be better off if you take crops that make lots of seeds, and the seeds aren't the part you eat. Take tomatoes, for instance. You not only get to eat the tomatoes, but you get to keep all those hundreds of seeds. That's your start for next season. If you take something like corn, you'll eat it all if you have a hard winter—there won't be anything left to plant."

Gwendolyn's eyes were narrowed. "Look, I don't appreciate you telling us how to run our lives."

Tina fixed her with a wry grin. "So you're admitting that you're going to Organala?"

"That's it! Get *out* of here!" Gwendolyn shouted, pointing at the door.

Tina didn't budge. "And which cargo hold were you planning on traveling in?" she asked sweetly. "The one that has air, or the one that doesn't . . . make the wrong choice and you'll look like road kill by the time you arrive on Organala."

Trying to defuse the tension between the two women, Liam said, "I gather that you're accustomed to not being liked, Tina, but wouldn't it be easier if you were a little more tactful? It might also help if you'd give us some idea of why you suddenly popped into our lives without so much as a how-do-you-do."

Tina sighed, a harsh sound as though she was a heavy smoker. "Okay, so my people skills aren't the greatest. Here's the deal. For five-hundred thousand, I will get you to Organala alive and with a reasonable number of possessions in hand. For one million, I will go with you and hold your hand along the way. In either case, I will advise you on what to take, what not to take, and how much

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to take. Believe me, there are a lot of people who want to take stupid stuff that they'll never need or use. That's wasted effort. Much better to trim things down so that you don't lug a bunch of crap halfway across the Universe, only to throw it away when you get there."

Liam was staring at her, mouth agape. "Five-hundred thousand . . . a *million?* Just to tell us what seeds to take? You must think pretty highly of yourself!"

Tina raised her eyebrow, grinning impudently. "What? You were planning on taking it with you? What were you going to spend it on? There's no need for money there. There's nothing to buy. The economy, such as it is, is entirely based on barter."

"And if we paid the million for you to go with us . . . what were *you* planning on spending the money on? Or perhaps you're not telling us the whole truth about money on Organala," Gwendolyn snapped.

"I didn't say I'd *stay* with you, dearie. I'd catch the next ship back here. Money still works here on Earth. I've gone on four round trips in the last two years."

"Nice racket," Liam said cynically.

"And every customer a satisfied customer," Tina added.

"Convenient that we can't ask them until we get there," Gwendolyn observed acidly.

Tina shrugged. "You don't have to take my offer, but I think you'll find that it's the going rate."

"There are *more* people like you?" Gwendolyn asked, her expression indicating that she had discovered a new class of vermin.

"Oh yeah, at least a dozen that I know of."

"And you're all getting filthy rich running this scam of yours," Liam said. "Perhaps I should quit farming and give it a try."

Tina gave a hoarse cackle. "Sure thing. That's how I got started. But bear in mind that it's hell on your marriage."

Brought up short, Liam nodded, looking bemused. "Yeah, all things considered, I think we're in this for the long haul."

"Good. That's what I figured. Now, let's get down to business. . . ."

Liam was asleep when the outside hatch slid open. His eyes sprang open in panic, but there was no one there. Just a smooth ramp extending invitingly down to the ground. Visible through the rectangular opening was a mountain range bathed in warm, sunset colors. Snow capped the highest peaks off to the left, but the lower ridges nearby were clear. The fresh outside air coming through the hatch was chilly. He rolled up on his elbow and shook his wife's shoulder. "Get up, honey! We're there!"

"*Ohmigod!* And it was my turn to watch." She was scanning rapidly back and forth, as though expecting Siltook to come out of the bulkheads. "I'm sorry, Liam. I tried to stay awake, really, it's just that it was dark and I—"

He shook his head. "There's no time for that. Let's get moving."

"You'd think we would have felt or heard something!" Gwendolyn spluttered.

"Later, honey, later . . . we need to get down on the ground."

He reached for his heavily laden backpack, grunting as he pulled it towards him. Gwendolyn was doing the same. He quickly closed the fastenings that he'd left undone after going for a candy bar sometime during the interminable darkness of the trip, then turned to check the ewe. She was groggy, but awake. He decided that he didn't trust her to walk down the ramp on her own, so he picked her up, staggering a bit as he tried to balance both the pack and the sheep.

"Do you think you can manage?" Gwendolyn asked, concerned.

"*Hunh!* I'll have to," he grunted. "At least until we're off the ship and under cover. Then we can rest. *Damn*, this

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critter's heavy!"

The long ramp was worse going down than it had been going up. To complicate matters further, the ewe started struggling in his arms before he reached the bottom and he nearly lost his balance. Gwendolyn grabbed his shoulders while he clapped a hand over the ewe's eyes so she could no longer see how far off the ground she was.

"All it will take is some Siltook getting bored and looking out the porthole and we're sunk," he muttered, trying valiantly to keep his balance.

"You'd think they'd keep a closer watch," Gwendolyn said.

Liam tried to shrug, but the weight he was carrying frustrated the effort. "There's no fence. Maybe they feel safe here. Maybe not. All I know is that we need to get under cover . . . fast."

They reached the bottom of the ramp and scrambled for the edge of a stand of something that looked like fir trees with purplish-black needles. Once far enough into the forest that they felt safe taking a brief rest, they sank to the ground. Liam gently laid the still partially sedated ewe on her side. She immediately began trying to stand, but fell over, panting heavily. Liam ran his fingers through her wool, speaking soft words, trying to comfort the poor, confused creature. After a bit, her eyes closed and she dozed.

"How long until we can give her another dose?" Gwendolyn asked.

"Are you sure we should? The less we keep her drugged, the better for the lambs," he said. "And besides, I don't want to carry any more weight than I have to. If she can walk on her own, then so much the better."

"We need to move on as quickly as we can. If she comes to while we're still within earshot of the landing area, they're likely to hear her complaining."

Liam sighed, but admitted that she had a good point. "Still, that leaves me carrying a hundred pounds of sheep in my arms in addition to my pack. I can't go much further like that."

"We knew we were traveling heavy, sweetheart. We thought we could handle it."

"That was then. This is now," he groused. He stood, looking further upslope. "Looks as though there's a ridge. I think I can manage to get her over that and into the hollow on the other side. Then I'll come back for my pack while you baby-sit Miss Maude."

"Miss Maude?" Gwendolyn inquired, eyebrow raised.

"It was something that occurred to me while we were on the ship—it'll be easier if she has a name."

She looked over to where the sheep lay on the ground, then nodded. "Miss Maude, huh? Sounds good to me."

Forty-five minutes later, he collapsed next to Gwendolyn in a small, mossy notch on the far side of the ridge by the simple expedient of squatting, then falling backwards on his pack. He was drenched with sweat in spite of the cool evening air. "I don't care if all the Siltook on the planet come after us, I can't go a single step further. Let's camp here for the night."

Gwendolyn gestured at the sheep. "Miss Maude isn't going anywhere. Even though she's still asleep, I tied the other end of the rope around the tree. Get your arms out of that pack and we'll eat before the light goes completely."

But as tired as Liam felt at that moment, he hardly slept at all during the night. Having been asleep when they landed, he simply wasn't ready to go back to sleep, no matter how hard he'd worked climbing the ridge. Finally, he thought to consult his watch. It was still early afternoon back home. Clearly, his body was going to have to adjust to what amounted to a different time zone.

He finally dozed off not long before local dawn, only to be awoken by Gwendolyn an hour later. "Rise and shine, sleepyhead. It's the first day of the rest of your life."

"I always hated that expression," he grumped.

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"Me, too, but if it was ever true, today is the day. We just slammed and locked all the old doors and opened a whole bunch of new ones. Let's go see what the options are."

He scowled at her. "My, my . . . aren't we obnoxiously chipper this morning?"

She grinned as she leaned over and kissed him. "I didn't sleep well, either, darling, but how can you be unhappy on a morning like this?" She gestured up the slope to where the first light of the morning was casting salmon-colored rays over the heavy blue shadow of the mountain. "It's beautiful."

He had to admit that there was something inexpressibly clean and pure about the chilly morning air, as though anything would be possible if he only willed it. "All right. But I bet we'll find ourselves running out of steam in the middle of the day."

It took all that day and most of the next before they managed to get to the crest of the mountains. They stood looking down on a wide valley filled with nearly black trees interspersed with a few open meadows. There were at least two that looked suspiciously regular and neat from their vantage point.

"Do those look like farms to you?" Gwendolyn asked. "Do you think we've found other people?"

Liam shrugged and leaned down to rub Miss Maud's head. "I don't know. Might be Siltook farms for all we know." He paused, then muttered, "I keep getting the feeling that this has all been too easy. Even if it hadn't occurred to them that anyone would want to hitch a ride halfway across the galaxy to be a squatter, you'd think they'd be more alert after they found Wilson's body."

Gwendolyn shrugged, palms up. "They haven't caught us so far."

He snorted. "I still don't like it."

She smiled wryly. "What? You wanted to have to struggle more? Run and dodge and hide and nearly get caught, just so it'd be more exciting?"

"Exciting, I can do without. It's the unanswered questions that get under my skin."

"It's a little late to turn back now," she pointed out.

He was silent for a moment, then said, "True." He exhaled noisily. "What the hell, let's get down the mountain before the Siltook swoop down on us."

They had made note of landmarks that they could use to find one of the fields that they'd thought might be farms, but once they got to lower altitudes the trees foiled them when they tried to see the landmarks, and it took several hours before they managed to locate a field. It did indeed appear to be under cultivation, and the plants appeared to be plants they were familiar with from Earth: corn, several kinds of beans, and watermelons.

A voice hailed them as they stood on the edge of the field. "Hey! Speak English?"

"Yes," Liam called back, spotting a man in his early thirties coming across the field towards them.

"Ya never know. The last couple that came in—they're German or something. Can't make heads nor tails of what they're saying. Seem nice enough, but it's awful hard to talk to them."

"We're from the United States," Liam said.

"Me, too," the man said, sticking out his hand. "My name's Todd Myers. My wife's Irene. She's down at the stream getting some water. It's not every day that we get someone new."

Liam introduced himself and Gwendolyn. "We saw a few fields as we came across the mountain, but we weren't sure whether they were natural or man-made. For all we knew, they might be Siltook farms."

Todd's brow furrowed. "You know, it's a funny thing . . . there are two or three dozen people up and down this valley, but no one's seen a Siltook since we got here."

"Two or three dozen, huh? Is there

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any land not taken? We were thinking about settling over that way." Liam gestured in the general direction of an area he and Gwendolyn had chosen while standing on top of the mountain.

Todd snorted. "There's some folks who've made big claims, but basically it's just a couple of acres here and there. No one has any draft animals or machinery, so all anyone can reasonably work is a few acres. Were you thinking about this side or the other side of the river?"

"The other side."

He waved a hand in dismissal. "That's no problem, then. There's only one family on the other side, and they're at least a mile or two downstream. One thing to look out for, though . . . when you cross the river, watch out for a big fish about three feet long. Got a mouthful of teeth. Irene got a goodly hunk taken out of her right calf a while back. It took forever before she healed. She still walks with a limp, but we hope it'll work itself out over time. I'll tell you this . . . she won't go near the river anymore. The little stream over that way is all the water she wants to see. It's too shallow for the big brutes."

Liam whistled under his breath. "Thanks for the warning. We'll be on the lookout for them."

The sun was already behind the flank of the mountain they'd been crossing, and it was getting dark in the valley. Irene came back from the stream, carrying a small, hand-made wooden bucket full of water in her left hand. In her right she carried a cane, upon which she leaned heavily. Todd and Irene invited them to spend the night, rather than camp in the woods again. The O'Malleys accepted gratefully.

Later that evening, they were sitting at a rustic wooden table answering Todd and Irene's questions about what had happened on Earth in the two years since they'd left. Liam's description of their own circumstances left Todd nodding.

"Yep. Exactly the same thing happened to us. *Exactly* the same. My daddy left me the farm since my older brother wasn't interested in messing with it. He wanted to be a lawyer. Turned out to be a good one from what I heard, but once he moved to the city, he didn't want to talk to country folk like me any more, so I don't know what's happened to him. Me . . . all I ever wanted to do was farm. The city's too noisy for me. But then they put the squeeze on me. Turned down my applications for permits for seed and things. Irene and I talked about it for a bit and thought that if Earth was getting that way, we'd sell the farm and maybe try things here. Wasn't long after that this guy shows up—already knows that we're wanting to come to Organala. Says he wants to help us get here, but the money he wanted . . . *whew!* But it's true, what he said. Ain't no use for money here. So we gave him what we got from selling the farm, plus what we had left from when Irene's mother passed, and he got us here."

"I always wanted to know how he knew we were thinking about coming here," Irene put in.

Liam sat tapping his fingertips against the rough surface of the tabletop. Finally, he shook his head. "There's something odd about all this. Damned odd. The problem is that I don't know how to go about getting answers. It's not as though we can walk right up to the nearest Siltook and ask for an explanation. We don't even know where they are—and that's the problem. I'll grant that you might not see them every day of the week, but you'd think that there'd be *some* sign of them."

"Nothing," Todd affirmed. "Neither hide nor hair have we seen. No contrails in the sky. No sound of engines. Nothing. It's as though we're the only ones on this planet. I suppose we could go looking for them, but we're living a hand-to-mouth existence and can't afford the time."

"And this business of guides showing

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up uninvited," Irene put in.

Gwendolyn frowned. "In our case it was a woman named Tina. I didn't like her at all."

"Give her her due," Liam said. "She might have been a little rough around the edges, but so far everything she told us has been accurate. Although Miss Maude has been a bit of a nuisance."

"Miss Maude?" Irene asked. "Is that your sheep?"

Liam nodded. "Tina suggested that we bring a pregnant ewe. The logic is good, but it's been a lot of work getting her here."

"In our case, it was bees. They're getting by, I guess, but there aren't enough flowers and such. Not like on Earth. You planning on planting anything with flowers?"

Gwendolyn nodded. "Lots of things we brought will bloom. Hopefully enough to do you some good. I know bees love oregano, and we'll have lots of that."

"*Oregano?* Name your price!" Irene begged. "We didn't think about bringing any herbs and although the stuff we're growing is wonderful, I'd ***kill*** for something to vary the taste. Let me know the instant you think you can let go of a little and I'll do your laundry, sweep your floors, anything . . . just name it."

"We've got corn coming out of our ears, so to speak," Todd added. "I know you folks are traveling heavy and you're tired, but you're welcome to a few ears. You can eat 'em or plant 'em, whichever."

They stayed up until late in the evening, but at last Irene begged off. "My leg's bothering me and I'm tired. I'm afraid I can't get around like I did before that shark got me. But you folks stay up as late as you want. I'll make some breakfast in the morning. It may not be fancy, but it'll get you through the day."

After eating the next morning, Liam and Gwendolyn set out towards the other side of the valley. By the time they reached the river, they had talked each other into believing that the shark-like fish would be waiting in schools to consume them, but they didn't see anything at all in the water. The anticlimax was almost disappointing.

It took them until dark to make their way back upstream to the place they had chosen from the mountainside three days previously. The light was nearly gone when they got there.

"Well, it took some doing, but we're here. Now, we get to find out what we can do on our own," Liam said, unshouldering his pack.

"Not tonight," Gwendolyn said firmly. "We'll start tomorrow. Tie Miss Maude to something while I start a fire."

Thirty minutes later, she went searching for him, only to find him stretched on the ground next to Miss Maude, snoring gently. She considered letting him sleep, but decided that he'd need nourishment if he was to be able to work the next day.

But within twenty minutes of having finished their meal, they were both fast asleep, curled in each others' arms.

Six months later, they had nearly two acres cleared and planted, a large pen for Miss Maude and her two lambs, and a small shack to live in. A more elaborate cabin was under construction, and they were beginning to experiment with clay, making their first crude attempts at firing crockery. Every night, Liam was up late reading from the one piece of high-tech equipment they'd brought with them—a solar-powered reader stuffed to the limit with every book they'd been able to buy, beg, borrow, or steal. Fiction, reference, classics, the works.

In the interim, at least two other families had arrived in the valley, both settling on the other side of the river, one upstream from where they were, one downstream. They had met one of the couples—a taciturn man in his late forties, and his wife, a merry woman they gauged to be in her mid thirties. They

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seemed oddly matched, but perhaps appearances were deceiving. The other couple they had not met yet—they were reputed to have been paramedics back on Earth—and there may have been others who had skirted the existing farms and begun farming farther up or down the valley without introducing themselves. No one knew how many other valleys might be under cultivation.

Working the ground with only hand tools was tedious and difficult, but it was producing results. They had eaten native plants the other settlers had recommended to them for the first month or two, until they were able to harvest their first crop of radishes, followed by a few other fast-growing vegetables. Now they had a continuing supply of Earth food, and were beginning to give thought to how to store some for the winter. According to Todd and Irene, it was mild and relatively brief, but it would be cold enough that most crops wouldn't grow. Over time, they'd work out more details, but there was little doubt that the first few years would be lean during cold weather.

Something they hadn't counted on was the paucity of land animals or birds, at least in the valley they were living in. Supposedly, someone had made a trip of a few days duration further east and seen animals, but there were relatively few in the immediate vicinity. Indeed, there weren't that many fish. They had discovered that the "sharks" could be caught in a weir. They weren't very good eating, but it was better than nothing. There were a number of smaller fish—presumably what the sharks ate—but they weren't particularly tasty, either, and tended to have a gritty texture for some reason.

Gwendolyn was looking up at the sky after breakfast one morning. "It just doesn't seem natural that there aren't any birds."

"Be glad, honey. If there were birds, they'd very likely be after our crops," Liam said, coming up behind her.

"Still, I don't like it. A place this beautiful ought to have some sort of songbird. It's too quiet. Do you think there's any way we can get bluebirds or something from Earth?"

"I think we'd better hope for more sheep so as to have someone to breed Miss Maude to. Besides, sheep are social animals, and she'd be happier if she had some company."

She turned and kissed him. "Still, I miss birds."

"Some of them are nice," Liam admitted. "Let's just make sure they don't send any crows, you know? It's nice not having to worry about anything eating our crops."

"What about those little things that look like slugs with feet?"

"I thought we'd decided those were animals, not bugs."

She shrugged. "Whatever. I'm not an expert. It's got legs. It climbs trees and corn. It doesn't act like an animal. It acts more like a bug."

"It's probably neither one. One of these days, we'll get some scientist-type from Earth, and he'll tell us that they're something totally unlike anything we were used to back home, all because of some reason that we won't be able to follow because we don't know Latin."

Gwendolyn giggled. "You know, it's funny. Everyone figured that the scientists would be the first ones to conquer space and live on other planets. And here we're the ones who've gone and done it . . . just regular people . . . farmers. And stowaways, at that. It tickles me every time I think about it."

"The American West was explored by trappers and farmers and prospectors long before the scientists got there," Liam pointed out.

"So why don't we do some prospecting?" she asked thoughtfully. "There might be gold or diamonds or something."

"Could be," he admitted. "But who would we sell them to? It won't do us any good to have a pot of gold that we

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can't eat or use to buy food with. Wealth implies a merchant class at the very least, and we're a long ways from that."

"You're thinking short term, husband mine. In the long run, we'll need currency. Barter is fine for some things, but currency will be more efficient later."

He stopped, lips pursed. "All right, I'll grant you that one. Tell you what . . . someday fairly soon we'll take a few days and roam around in the hills. There might be something up there worth having."

"How about panning in the river?" she asked.

He shook his head. "Nope. Supposing we *were* to get stuff from the rivers . . . everybody'd be panning in no time. Then we'd all be on an equal footing, and no one would want what we have. We'll have to find something that's not so readily available."

She nodded. "Scarcity creates demand."

"That's the idea." Frowning, he added, "Speaking of scarce . . . it bothers me that we *still* haven't seen a Siltook. You'd think that they'd fly over or drive by or something. Yet there's no sign of them anywhere."

"Well, there was the landing thingy—airport, spaceport, or whatever you want to call it," she noted.

"And what else?" he asked. "When have you ever seen an airport out in the boonies? They're always near a city, right? Think back. There wasn't a city. Nothing. Just the landing pad."

She blinked, suddenly uncomfortable in some way that she couldn't quite define. "Maybe they want to keep noise away from their homes."

"Then surely there'd be shuttle flights going over or driving by or something," he countered. "They'd have to get from the landing pad to wherever they live and work."

"Liam, what are you saying?" she asked uneasily.

He took a deep breath. "I don't know. But there's something wrong with this place. The pieces of the puzzle don't fit. Perhaps when we go looking for El Dorado we should take a look at that landing area. I want to know where the Siltook go."

Two days later, Liam O'Malley was spading the soil by hand, breaking it up, tossing rocks to the side, and sweating copiously. He'd never worked so hard in his life, but he was enjoying it. He was pitting himself against nature, betting that he could wrest a living from the soil. So far, he was winning the bet.

Now, if only he could figure out a way to get rid of the damned fleas, he'd be well on his way to living in a rural paradise. In some manner, fleas had managed to make the trip from Earth. Whether on Miss Maude, the Pasternaks' pig, or on the stupid cat the Robertsons had brought, he wasn't sure, but somehow the confounded things were thriving. He was able to see a grim humor in it, what with the fleas riding on the animals, which were traveling with the humans, who in turn were stowing away on the Siltook's ships. Who knew what tiny creatures had ridden the fleas to Organala?

His shovel blade struck a stone under the surface of the ground. He cursed, stopping to mop his brow on his sleeve. It would be nice to have a tractor, but there was no fuel to run it, and no place to buy parts if it broke, so they were forced to work with hand tools. Clearing land with only manual labor was hard work.

Probing, he discovered the size of the stone—about twice the size of a dinner plate. He dug down around the edges, then, setting the shovel aside, he worked his fingers around the edge of the stone, seeking a grip. His shoulder muscles knotted with the strain, but he couldn't budge it. Slipping the shovel under the edge, he levered downwards with all his weight.

The handle on the shovel broke.

Panting, he hung his head, frustrated.

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It was the third time he'd broken a handle since they'd arrived. Now he'd lose a day going into the forest, looking for just the right piece of wood, cutting it, bringing it back, whittling it down, fitting it, and finally installing it into the shovel blade.

Damn.

The sweat dripping from his nose fell into his shadow, leaving tiny dark spots on the soil. Suddenly, his shadow grew much larger. It was a sharp-edged shadow—not made by a cloud. He looked up to see a flat, oval platform with a rail hovering near him. There were two Siltook on the platform regarding him steadily. What their expressions meant, he had no idea. He'd never met a Siltook and had no idea how to read one's face.

He made a gracious gesture for them to land. It was either the height of arrogance or the least he could do, considering that he was no better than a squatter on their land. The craft landed with no more sound than the compacting of loose soil. He quickly laid the remains of the shovel on the ground and went to stand by the opening that formed in the rail. He looked closely, but could not determine how the gate had formed. Oh well, that was the least of his worries at the moment.

"Good afternoon," he said evenly. "I'm sorry, but I don't know your language."

"We have learned some of your language," one of the Siltook said, stepping from the platform to the ground. "And we brought an interpreting device in case we need it."

Should he beg forgiveness, or take a bold stance? He had no idea where he stood with regards to any applicable Siltook laws. He'd stowed away on one of their ships, cut down part of their forest, eaten their fish—

The Siltook began, "Liam O'Malley, we are going to make one last trip to Earth, and we are . . . taking orders, you might say, before we leave this planet. Making a list of things you need. We already have you down for several rams and many more ewes. What else would you like? A new shovel?"

"*What?* Leaving? But this is *your* planet!" he spluttered. Had they ruined Organala for the Siltook? Polluted it with their presence?

The Siltook bent and picked up a clod of dirt, breaking it between flat, paddle-shaped fingers twice as wide as Liam's, but only half as long. He looked at the small stone that remained, then pitched it into the woods behind O'Malley with a curious side-swing. It rattled into the branches. Then he focused on Liam again. "Our planet? Yes, but not in the manner you've been led to believe."

The conversation felt like verbal quicksand to Liam. He wasn't sure where the reassuring solidity of fact could be found. "I don't understand."

The Siltook's face . . . *spread*, for lack of a better word. Liam assumed that it was equivalent to a smile. "You weren't meant to. Not until it was too late."

Liam took a deep breath. He heard Gwendolyn coming up behind him. "I know I'm not in a position to demand an explanation, but I would appreciate one."

The Siltook nodded stiffly to Gwendolyn. "Good afternoon, Mrs. O'Malley. Your husband and I were just discussing our imminent departure from this planet."

Out of the corner of his eye, Liam saw her eyes widen, but she said nothing.

The Siltook held up a dirty finger, the one he'd used to crush the dirt clod. "You are breaking the soil. This is what a farmer does, prior to planting seed, yes?"

Liam nodded. "Yes. I had intended to plant beans here."

"And for that, you need a shovel. The shovel is a tool, yes?"

Involuntarily, Liam glanced at the broken shovel nearby. "Yes."

"In much the same manner, we are farmers. We began adapting this planet many, many thousand years ago. We

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changed the atmosphere, seeded it with primitive life—later with a few more advanced species—including some that you will eventually find suitable for draft animals—but there are still things to be done to bring this planet to its final state of readiness. We use other races as . . . tools to farm our planets, in much the same way that you use a shovel. You are here to break the ground and make it productive. You will finish this planet for us."

"But we—"

The Siltook's face stretched again. He raised a hand, edge-ways. The gesture meant nothing to Liam. "You thought you were stowaways. You weren't. Not really. Didn't you find it curious that it was so easy to get on our ship? Especially burdened as you were with a bleating animal? Did you not wonder how Tina Cartwright found you and knew all about your intention to come here?"

"Well, yes, but—"

"It was all arranged. We own—through a holding company—the corporation that bought your farm. Once we knew that you were considering boarding one of our ships, we sent Tina Cartwright to you to guide you through the process and make certain that you didn't make any unnecessary mistakes. The fact that we were the ones who bought your farm meant that we knew how much you had been paid for it. That way Tina Cartwright knew how much you could afford to pay for her services. Her fee varies according to how much money you have."

"But she was human," Gwendolyn protested. "She wasn't a Siltook."

"Of course she was human," the Siltook agreed. "You would have been suspicious of a Siltook."

Liam was getting more confused, not less. "But if you were interested in having humans immigrate—for whatever reason—why didn't you just say so?"

"And what sort of people would we have gotten then, Liam O'Malley? People like your neighbor back on Earth? When he sold his farm, he quit entirely and got a job in St. Louis. We wanted people who were *determined* to farm. Who would accept exile from Earth rather than quit farming. We did not want those who would treat it as a vacation. We did not want those who would wish to return to Earth if things went poorly. They would not be an asset, either to us . . . or to you. They would be a burden. Note that not one of you humans has a close friend or relative left on Earth. All who still had ties were discouraged from making the trip. Only those who, quite frankly, would not be missed were allowed to make the journey. You will take this planet from its current wild state to that of a garden planet."

"You're *using* us!" Gwendolyn raged.

"As you were using us," the Siltook pointed out patiently. "Or you thought you were. It is too late now to protest that you are innocent."

"But what will happen to us when Organala gets done?"

Again, that unnerving stretching of the face. "Gwendolyn O'Malley, who told you this is Organala? It isn't. Organala is indeed our home planet, but it is far from here. This is Faelnoh."

"This *isn't* Organala?" Gwendolyn gasped. "But . . . but, why?"

"I've already explained. We judged that the best way to cultivate the planet would be to turn it over to humans. Afterwards, Faelnoh will be nearly as perfect as Organala and we will begin colonization."

"And what will happen to us?"

"Nothing will happen to *you*. You will live out your lives. You will plant crops and harvest them. In the process, you will till the soil, remove the rocks, and make the places where you live suitable for splendid gardens. We will then move you to new locations and you can begin again. We estimate that the planet will require a century or so before the first Siltook take up residence here. Perhaps even longer. Many other places here on Faelnoh will require your touch when

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you are done here in this valley."

"But what happens when there are no more places? Where will we go then?" Gwendolyn demanded.

"At that time, perhaps we will have another planet ready for cultivation."

"So you'll just deport us when Faelnoh is done?" Liam demanded.

The Siltook looked at him. "When you put a tool in the shed, do you ask its permission? You have a full lifetime ahead of you. Enjoy it."

As the Siltook craft floated silently away to the south, in the direction of the other farms, Gwendolyn O'Malley could hear her husband muttering under his breath. She stepped closer, straining to hear. He was cursing—slowly, steadily, monotonously.

"Liam?" she began.

He turned, took her head in his hands, and kissed her gently on the forehead. Then, without saying a word, he started for the shack, his stride purposeful. She trotted afterwards, but was unable to keep up with him. By the time she reached the door he already had his backpack out, and was angrily throwing items into it.

"Liam?" she began, perhaps too quietly. He did not seem to hear her.

She placed her hand on his shoulder. "Liam?"

He looked back over his shoulder at her, eyes smoldering. "Granted, we hitchhiked here, thinking that we were sneaking one past the Siltook. Whether that was fair or not . . . well, it probably wasn't. I was willing to pay a price if caught—that was the risk we ran. But to find that they were playing us for fools the whole time . . . they will discover that it's not a good idea to make a fool of me."

"You're not going to go after them, are you?"

He rammed a cap into the backpack. "Furthest thing from my mind! If I *ever* see another Siltook, it will be too soon." He shook his head. "No, I've got other plans."

Her face reflected her confusion. "Plans? What plans?"

Liam made a long arm and grabbed his last pair of socks and a large sheath knife, turned and threw them in the pack, then tied it off with a savage jerk. He slung the pack over one shoulder and made for the door, stopping just inside. "When the Siltook come back, I want our descendants to be able to look them in the eye and say, 'No, you will not take this world from us.' We will build a society so deep-rooted that they won't be able to simply walk in and toss us aside. We're not just some seed that they can plant, then come back and harvest. We're going to run wild, like weeds. They have made a mistake. They will find that just because I want to farm does not mean that I'm not versatile enough to learn to do something else. I can. I will. I must."

She gestured at his pack. "Where are you going? What about the crops?"

"Remember when we were talking about going out looking for gold and gems the other day?"

She nodded. "Yes."

"As of today, I'm no longer a farmer. I'm a miner. I'm going prospecting."

Her brow furrowed. "For gold and gems? How will that help? There'll be plenty of time for that later."

"Gold? Gems?" he sneered, making a dismissive gesture. "Who needs 'em? There's serious work to be done, and pretty baubles won't do the job. I'm going after something more valuable in the long run—more fundamental."

There was a fierce, proud light in his eye as he added one word. "Iron."

And with that, he began to climb the mountain. ■

Adventure is worthwhile in itself.

—Amelia Earhart

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Babel

Steven Utley

The scariest part of this is how little is fiction!

Host: Hello, and welcome to another edition of "Alternate Mindsets." Our guest this evening is Doctor James Farlough, founder of Advocates for Biblical Creation and author of several books on the faith-based sciences. Thank you for being with us, Doctor.

Farlough: I'm happy to be here. I must correct you on one point, however. My father, Doctor Farlough Senior, founded the A.B.C.s.

Host: Of course. My apologies. Doctor Farlough Junior is here to share his views on the so-called spacetime anomaly that's been so much in the news. Later in the program we'll field questions from callers. But, first of all, to head off some of the more obvious questions, can you tell us what this anomaly is—besides being unprecedented in history? How would you describe it?

Farlough: I don't claim to be able to describe its actual physical aspect, assuming it even has one. I'm a geologist, not a physicist. Inasmuch as this phenomenon can only be described in either the most abstruse mathematical terms or else metaphorically, in the most elementary language, let's spare ourselves the math and call the anomaly a gateway. Humans are able to pass through it and return, evidently little the worse for wear.

Host: What is it a gateway *to?*

Farlough: Indeed. What and *when?* To a primeval Earthlike planet, some establishment scientists say, that exists in another universe virtually indistinguishable from our own. This makes me wonder how they can tell it from our own. Others say this planet is in fact our own Earth at the dawn of time—though they can't agree among themselves whether the term "dawn of time" means the Silurian period in this case, or the Devonian! As to its being unprecedented, there's not the slightest doubt in my mind that the anomaly has been created, or at least revealed to us at this time in human history, for some great purpose.

Host: What might that great purpose be?

Farlough: What are scientists to do but go through and find out what that purpose is? By scientists, however, I mean *true* scientists, as opposed to members of the conservative uniformitarian-evolutionist establishment. [*Laughs.*] That's quite a mouthful, isn't it? And I didn't even get in "relativist" and "indeterminist."

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Host: Before we go any farther, it might be a good idea to define those terms as well for our audience's benefit.

Farlough: Uniformitarianism is the doctrine that geological phenomena result from observable processes that have operated in a uniform way throughout time. Evolution, of course, is the supposed development of all animal and plant species by means of hereditary transmission of slight variations in successive generations. I'm not sure I can give you a good thumbnail definition of indeterminacy as the word is used in physics. Or perhaps I should say misused. Anyway, indeterminacy pertains to the supposedly inexact limits of matter. Relativity is a whole other episode of this program! [*Laughs.*]

Host: Let us know when a good time is for you, Doctor. [*Laughs.*]

Farlough: Anyway, suffice it to say that indeterminacy and relativity posit a heinous lack of absolutes. The antitheses of uniformitarianism and evolution are flood geology and creationism. The essential statements of flood geology are that the Noachian deluge described in scripture was an historical event; that modern landforms were shaped by the waters of that deluge; and that the geological record, when properly deciphered, overwhelmingly supports the case for the creation of our world and everything in it, including ourselves, in a fairly short time and at a fairly recent date—very recent compared with the millions and billions of years uniformitarianism and evolution require to work their alleged changes.

Host: What distinguishes true scientists from, well, false ones?

Farlough: A true scientist keeps an open mind. He is ready to alter his own mindset if facts warrant, even if the facts seem incredible. Establishment scientists are fanatically devoted to their model of Earth history. One could go so far as to say that they are hopelessly trapped in it. The most charitable assessment possible of their attitudes and opinions is that they lack the proper search image to discern truths that fly in the face of their alleged facts. Less charitably, one could say that their colossal arrogance is matched only by their gigantic ignorance. The sum of things they do not know and refuse to learn is staggering. The *true* scientist prizes science as an invaluable system for learning about the physical world, yet recognizes that the basis of good science must be spiritual. Without the solid foundation which only inerrant scripture can provide, science is worthless and worse than worthless. It is like the house built on sand—not merely unsound but actually unsafe for all who choose to dwell therein. The true scientist formulates a sound theory and then amasses the incontrovertible evidence that supports it.

Host: But what if the incontrovertible evidence doesn't support a theory—say, the theory that life on earth, particularly human life, owes its existence to intelligent design?

Farlough: Good evidence has often been misinterpreted, or deliberately misrepresented, to support bad theories. The data collected by people who've passed through the anomaly are a case in point. Those people are all establishment scientists. It's hardly surprising that their data should be badly skewed.

Host: Is your organization interested in sending its own people through?

Farlough: Oh, yes, absolutely. The anomaly beckons us to a world both strange and strangely familiar. A world that promises us the means by which to achieve our greatest, our final victory over establishment science.

Host: Why is that victory so important?

Farlough: Much of the wickedness and misery of our world is directly attributable to the immoral and pernicious doctrines of evolution, uniformitarianism, relativity, and indeterminacy. Establishment science's embrace of brutal mechanical processes and its rejection of absolute values have demoralized hu-

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man civilization. Yet adherents of fallacious doctrines are formidable and well-entrenched, and they control access to the anomaly. The National Science Foundation holds the purse strings. They're going to oppose us every step of the way. Once we've won through, and we will win through, eventually, I hope to be a member of the, um, the first, ah—

Host: Unbiased? Unprejudiced?

Farlough: I believe impartial is the word I'm groping for. The first impartial expedition to pass through. Oh, and the anomaly's possibilities are simply dazzling. I hope to have the pleasure and the satisfaction of securing the kind of proofs that will stand the scientific community on its head. Proofs that will be the ultimate weapons against the terrible cosmology which secular science has fashioned. Uniformitarianism will crumble away when we present conclusive proof that modern landforms were chiefly shaped by the waters of the Noachian deluge. Evolution will go at last into the dustbin of history when supposedly more advanced organisms are discovered coexistent with supposedly more primitive ones in so-called Silurian or Devonian ecosystems. Astronomical observations will corroborate the work done in Newtonian optics, proving that the Universe is not only much younger, but much smaller than establishment science says. Then, goodbye, Einstein! Relativity will join evolution in the same unmarked mass grave. Colleagues who have a much firmer grasp of mathematics than I do tell me that impartial scrutiny of the anomaly itself might well expose once and for all the fallacy of Heisenberger's indeterminacy. I can cite instances beyond number when maverick researchers have come up against the obduracy of the scientific establishment. Unless a fact fits their unproved theories of a very ancient universe and the ascent of humans from animals, they ignore it, deny it, and try to suppress it.

Host: Please give us just a couple of instances.

Farlough: Among the facts they disregard as a matter of formal policy is that man tracks and manmade artifacts turn up in supposedly very old rock formations dating back to so-called Cambrian time. According to uniformitarian geology, that was 560 million years ago, long before life moved ashore, never mind gave rise to humans. But during the 1820s, the naturalist Lea discovered an anomalous artifact in a quarry near Pittsburgh, in the Silurian sequence, supposed to be at least 400 million years old. The object was a flat rectangular surface, three feet long, six inches wide, adorned with perfectly spaced diamond shapes. Obviously, it was no fossil animal or plant, but an artifact fashioned by human hands. Another important find was made sixty years later by a Doctor Booth, in Missouri rocks dated even earlier in the Silurian sequence. He discovered a human skull and other remains, and even an impression of reed matting.

Host: We have a number of callers on hold who have questions or comments. Let's hear from them. Caller, you're on the air.

Caller # 1: Hello?

Host: Yes, you're on the air, go ahead, please.

Caller # 1: Uh, I've always been sympathetic to groups like the A.B.C.s, because I don't think people came up from apes. But I've been following this story about the spacetime anomaly since day one, and I'm still not convinced it even exists. Uh, it's like they can't say if it's, like, a thing or a place or what. All this stuff about people going back in time to a prehistoric world—I mean, I learned in school that thermodynamic law says time can only run in one direction. As far as I'm concerned, time *still* runs in one direction and one direction only. The spacetime anomaly's a hoax, and the A.B.C.s have been taken in!

Host: Comment, Doctor?

Farlough: To be sure, during the past 200 or so years, the scientific establish-

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ment has perpetrated and perpetuated a monstrous catalog of hoaxes. Nevertheless, qualified individuals who are sympathetic to the A.B.C.s' ends have confirmed the anomaly's existence.

Host: You have people undercover at—

Farlough: No. Of course not. The point is, ah, the anomaly is real. It wouldn't be anomalous if it didn't violate at least one *generally* applicable law of nature. Its existence actually proves a major point creationists have long insisted upon, that the laws governing the physical world can be suspended—miraculously suspended.

Host: Next caller. Hello, you're on the air.

Caller # 2: Yes. There's a lot of speculation that Paleozoic time corresponds to the days of creation, or perhaps the days before man's fall from grace. I'd like to ask the doctor what his opinion is.

Farlough: Modern people have already visited the ancient world for periods far exceeding the six twenty-four-hour days of creation. Moreover, common sense tells me that *creatures*, which is to say, created beings such as ourselves, cannot be present before or at their own creation. Nor do I think people from our age of abominations would be permitted to enter the world as it existed before man knew sin. For us to do so would be to import sin into that pristine and paradisiacal world.

Host: Raising the question of where original sin came from originally.

Farlough: Ah, yes. Nor do I think, as some would-be schismatics in our organization do, that the world beyond the anomaly is a sort of trial earth, a rough draft of the real world that was later created for us to inhabit. This notion is dangerously akin to the secular physicists' hypothesis of many universes. I believe only the one set of heavens and the one Earth were ever created. It follows that the anomaly is a means of traveling through time rather than to another universe in another dimension. As for those who wonder if the anomaly might not be of diabolical rather than divine origin, that it is an infernal lure or trap—or, to say it another way, that just because we *can* travel through time doesn't mean we *should* or we're *supposed to*—I can only counter with my firm belief that the anomaly is the means by which we will at last and for all time rout the scientific establishment. We shouldn't pass up the opportunity of the ages because it is given us by our secular adversaries of old.

Caller # 2: Is there going to be any way for us to definitely fix this other world in historical time?

Farlough: My father, Doctor Farlough Senior, is preparing a list of simple experiments which should allow us to reach useful gross conclusions. Predation, of course, did not exist before sin came into the world. Observing the eating habits of animals as different as cats, ladybugs, sharks, and dinosaurs like the tyrannosaur will be instructive. Also, before the flood, there was no rain, but moisture that rose up from the earth. And there were no earthquakes and volcanoes. Obviously, the incidence or non-incidence of these natural phenomena will be good general indicators. By the way, my father, who has been fascinated by dinosaurs since he was a boy, is especially keen on settling the matter of whether that race of terrible lizards died out in the flood or persisted into, and perhaps even beyond, the lifetimes of the patriarchs. He also hopes to prove that certain dinosaur types possessed the same fire-producing mechanisms that bombardier beetles do. Whence, the fire-breathing dragons of supposed legend.

Host: Doctor, dinosaurs are conspicuously absent from the world beyond the anomaly. In fact, the only land animals reported so far are scorpions and millipedes and the like. There are hardly even any land plants.

Farlough: There are several possibilities. One is that we have only begun to

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explore this ancient world. What have we seen of it so far? A few rocky islands and a lot of open sea. A second possibility—which is not precluded by the first—is that the people who've gone through thus far are incompetent observers, liars, or both. *Or* they've visited the world as it was in the immediate aftermath of the deluge, which would account for the denuded landscape and the absence of large land animals. Scorpions and millipedes breed faster and more prolifically than the larger types of animals in the Ark—including dinosaurs. As I said, probably the waters are still retreating, and Babel, the first postdiluvial civilization, hasn't arisen.

Host: Caller, you're on the air.

Caller # 3: I had a question, but I can't remember what it was. I'm still trying to digest the idea that Tyrannosaurus started out as a vegetarian. Sorry.

Host: Next caller. Hello, you're on the air.

Caller # 4: You talked about man-made artifacts in Silurian rocks. So why didn't the guys who found them come forward and blow Darwin right out of the water? How come nobody's ever heard of them?

Farlough: Unfortunately, before Lea could remove the artifact he found, a quarryman broke it up. And the relics Doctor Booth discovered turned to dust when he touched them. Great losses to science. These two finds by themselves probably would've nipped evolution and uniformitarianism in the bud.

Host: Caller, you're on the air.

Caller # 5: Hello. I'm a long-time follower of "Alternate Mindsets," but I gotta say, the show used to be a lot more entertaining back when it concentrated on people who'd squared the circle or been taken for rides in flying saucers.

Host: Caller, do you have a question for Doctor Farlough?

Caller # 5: You bet. The doctor mentioned the civilization of Babel. Does he mean as in "the tower of"?

Farlough: Yes. Of course. The civilization that was cast down following the confusion of tongues. Almost all traces of it were obliterated by glacial ice.

Caller # 5: [*Laughs.*] Well, that sure saves real scientists the trouble of looking for it on the other side of the anomaly, doesn't it?

Farlough: By real scientists you obviously mean establishment scientists. I'm sure they wouldn't find it even if they looked for it. They wouldn't look in the right places.

Host: Caller, you're on the air.

Caller # 6: Yes, hi, this is Marvin Canepi, I'm with the Institute for Extraterrestrialist Studies. I want to ask Doctor Farlough how his A.B.C.s expect to prevail single-handedly against the whole scientific establishment.

Farlough: [*Groans.*] Somehow I just knew I'd be hearing from Mister Canepi.

Host: You two know each other.

Farlough: Only too well. I have never known him not to show up wherever I may be. Waiting for him to call in tonight has been like waiting for the other shoe to drop.

Canepi: The A.B.C.s recently rebuffed overtures made by the I.E.S., the Advocates for Intelligent Design, the New Shaverite Church, and several other organizations. A coalition of—

Farlough: The problem we at the A.B.C.s face is to find such help as we can while exercising some discretion about whose help we accept. If we are to succeed in our purpose, we must be taken seriously by people in public office who can possibly influence the N.S.F. In order to be taken seriously, we must avoid association with the adherents of such dubious intellectual stuff as psychic phenomena, spiritualism, reincarnation, astrology, witchcraft, lost continents, the hollow earth, and, in this case, exobiology. Just because our enemies delight in portraying us as pseudoscientists and wild-eyed crackpots doesn't mean we have to tolerate individuals who really are pseudoscientists

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and crackpots. As our mothers used to tell us, "You're known by the company you keep."

Host: Next c—

Canepi: Wait a second, I'm not through yet. Talk about ignoring evidence—Doctor Farlough dismisses my organization's findings about ancient carvings collected from around the world. These carvings depict beings dressed in what can only be futuristic pressure suits and helmets. Ancient writings also mention these beings. They're described as wise, powerful—able to soar through the heavens in flaming chariots. They're possessed of technology so advanced it seems magical to backward Earth people. Obviously, these beings were visitors from another planet, maybe even another galaxy. And they obviously were responsible for the quantum leaps in human progress during ancient times. The suddenness with which distinct human civilizations appeared in Mesopotamia and the Nile and Indus valleys tells us that the visitors willingly shared basic technology. The—wait, don't cut me off, you ba—

Host: Doctor Farlough, can you comment on what Mister Canepi says?

Farlough: Comment and then some! Mister Canepi's organization is one of several that purvey secular extraterrestrialism, a doctrine as nonsensical as Darwinism. It rests on nothing more substantial than a wishful—one could even call it childish—interpretation of the ancient carvings and writings he mentions. Those relics exist, to be sure. But if the carvings actually depict anything that ever existed outside the pagan imaginations of primitive humans, they surely depict not ancient astronauts but modern time travelers!

Host: Time travelers!

Farlough: Yes. The people who've gone through the anomaly wear spacesuit-like raiment and headgear. Think of the impression they must make on unsophisticated ancient peoples!

Host: Umm, well, no one who's gone through claims to have *seen* any ancient peoples, unsophisticated or otherwise.

Farlough: No one has *reported* seeing any ancient peoples. And while we're on the subject of sophistication or the lack thereof, let me say here that even the I.E.S. and the A.I.D.s would do well to avoid the New Shaverite cult. I can't call it a church, with its subterranean race of malign robots and its angels and devils zooming around the solar system in spaceships.

Host: Are there any groups whose help the A.B.C.s would welcome?

Farlough: Despite what Mister Canepi says, we are not trying to take on any government agency by ourselves. We're solidly aligned with the All-American Front in a campaign to break the tyranny of the National Science Foundation. That's an absolutely necessary step, because as long as the N.S.F. is calling the shots, I doubt we are going to get anywhere near the anomaly, never mind through it. Despite its grandiose title, the N.S.F. doesn't bestow its favor on just any taxpaying knowledge-seeker. Certainly not on anybody who doesn't knuckle under to orthodoxy.

Host: We have time for one more question. Caller, you're on the air.

Caller # 7: Well, after what Doctor Farlough just now said, I'm not going to bother to ask the question I meant to ask. But I have two comments I'd like to make. First, you've never gotten anywhere with the N.S.F. because it has its reputation to consider. It can't have people getting the idea it'll knuckle under to loonies. Second, if you think the All-American Front isn't a bunch of wild-eyed crackpots, I'd like to know who is. I've read the Front's literature. One of the many fascinating things I learned from it is there're three distinct races of human beings—white, darky, and heathen Chinee—who shouldn't intermix or be *allowed* to intermix. You've thrown in with a bunch of neo-Nazis, Doctor Farlough. What the—

Host: Sorry to cut you off, caller, but

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we really are just about out of time. [*Whistles, laughs.*] Emotions run high on this show.

Farlough: That last caller sounded like a neo-Menckenite to me. Talk about wild-eyed crackpots.

Host: I want to thank you for being with us, Doctor Farlough, and wish you luck in getting to lead your expedition through the anomaly. We have about a minute left. Any closing statement you'd like to make?

Farlough: I'd like to end on an optimistic note. I think the A.B.C.s and the All-American Front and others who share our values and concerns are going to win through to the end. I take heart from the long, hard-fought, but ultimately successful campaign to dismantle the National Endowment for the Arts. Ever increasing numbers of American taxpayers, good decent citizens, are starting to realize that if they no longer have to underwrite so-called art that offends their sensibilities, neither should they have to underwrite so-called science that attacks their most dearly held convictions about mankind's special place in the scheme of things. It isn't merely a spacetime anomaly that's opened up, but a new front in the age-old war for men's minds, hearts, and souls. We won't be found wanting. ■

First-rate people hire first-rate people; second-rate people hire third-rate people.

—Leo Rosten

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Introducing the Pentaquark

Particle physicists, over the last 50 years, have discovered several hundred strongly interacting "elementary" particles. The list of such particles begins with the proton and the π meson and goes up from there. We now understand that all of these particles are actually composites, formed from various combinations of quarks. Such particles are normally classified in two types. *Mesons* (the name implies medium weight) are particles with masses that go up from 140 MeV/c^2 and have an intrinsic angular momentum or "spin" that is an integer in units of (Planck's constant over 2π). *Baryons* (the name implies heavy weight) are particles with masses that go up from 938 MeV/c^2 and have half-integer spin. This column is about the discovery of the *pentaquark,* a brand new form of matter that represents a new particle species, neither meson nor baryon, but a combination of both.

Our current standard model of particle physics, which is called quantum chromodynamics or QCD, describes all particles that interact through the strong force as being made in one of two ways. Either the particle is a meson—a combination of a matter quark and an antimatter quark (**q q-bar**)—or else it is a baryon—a combination of three quarks(**q q q**). An antimatter baryon (or antibaryon) is an equivalent combination of three antimatter quarks (**q-bar q-bar q-bar**). The lightest meson, the π^-, is an example of a two-quark particle and is made of one up quark and one antidown quark (**u d-bar**). The lightest baryon, the proton, is an example of a three-quark particle and is formed by two up quarks and one down quark (**u u d**).

The Particle Data Group is a consortium of particle physicists that maintains a roster of all known strongly-interacting particles, with separate listings for mesons and baryons. They list 148 mesons and 130 baryons in their latest particle tables. Until the pentaquark appeared on the scene, we could confidently say that *all* of the strongly-interacting particles (with the possible exception of the hypothetical "glueball," which we will ignore for now) were either 2-quark mesons or 3-quark baryons.

The tables of the Particle Data Group classify particles on the basis of their mass-energy (usually put in parentheses in units of MeV/c^2 after the particle symbol) and their "quantum number" characteristics. Quantum numbers represent conserved quantities (charge, angular momentum, quark flavor . . .) represented by integers or half-integers. One important quantum number is "strangeness," which is a count of the number of antistrange minus strange quarks present in a given particle. Thus, the $K^-(494)$ meson (**u s-bar**) has a mass of 494 MeV/c^2 and a strangeness S=+1, while the $\Omega^-(1672)$ baryon (**s s s**) has a mass of 1,672 MeV/c^2 and a strangeness S=−3. Mesons can contain at most one strange or antistrange quark, and so can at most have strangeness S=±1. Matter baryons, composed of three matter

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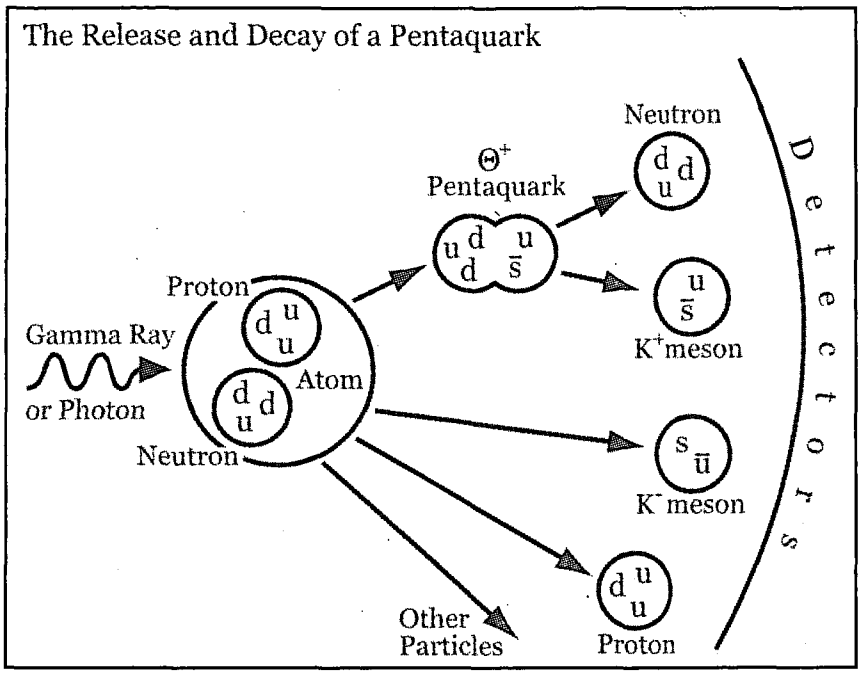

Illustration by Wolf Read

quarks, cannot have positive strangeness, since they cannot contain any antistrange quark constituents.

The strong-force equivalent of electric charge that is carried by quarks and gluons is called "color" and comes in three color-charge values, often called red, green, and blue (primary colors that are easy to draw on overhead transparencies). Antiparticles carry the negative equivalents of these colors. The "color confinement" aspect of QCD requires that quarks must combine so that no net color charge remains, so that any resulting particle is "color-neutral." Color neutrality is achieved in mesons by canceling a given quark color with the corresponding "negative-color" of an antiquark in a quark-antiquark pair. It is achieved in baryons by having a quark of each of the three colors in the same particle to form a color-neutral three-quark triplet.

However, QCD suggests that there may be other possible ways to produce color-neutral quark combinations, and that particles using these schemes may have "exotic" quantum numbers that are impossible for normal mesons and baryons. For example, a particle could combine several quark-antiquark color-canceling pairs, it could combine several three-quark triplets, or it could mix quark-antiquark pairs with three-quark triplets. Thus a 6-quark combination might be either a "super-meson" made of matter/antimatter pairs of up, down, and strange quarks (charge=0, strangeness=0; never observed), or a double "strangelet-baryon" made of 2 triplets of up, down, and strange quarks (charge = 0, strangeness = -2; never observed).

Another alternative is the pentaquark particle, which has 5 quarks (or more precisely, 4 quarks and 1 antiquark), i.e., combining a quark pair with a triplet. Such a configuration, which could produce an "illegal" S=1 baryon-like particle, was suggested some decades ago, and there have been many experimental

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searches for such particles. However, as it turns out, the searchers were looking too high in mass-energy.

In 1997, a theoretical paper predicted that pentaquarks might exist as "chiral solitons," and that the lowest-mass member of this set of pentaquarks, which the authors called the $Z^+(1530)$, should be a 5-quark combination having two up and two down quarks along with one antistrange quark (**u u d d s-bar**). The antistrange quark has a strangeness of +1, which therefore gives the $Z^+(1530)$ a net strangeness of S=1. This is a "forbidden" quantum number, because no 3-quark baryon can have positive strangeness.

The Z^+ pentaquark is predicted to be the low-mass member of a 10-element set of particles (an antidecuplet), all with similar 5-quark compositions. Other particles of this group that have forbidden quantum numbers are the highest-mass, strangeness S=-2 members of the decuplet, the $\Xi^-_{3/2}(2070)$ (**u u s s d-bar**) and the $\Xi^-_{3/2}(2070)$ (**d d s s u-bar**), which have electric charges, respectively, of +1 and -2. These exotic pentaquarks, which have not yet been seen experimentally, have forbidden quantum numbers because there can be no 3-quark baryon with a charge of less than -1 and no positively charged baryon with a strangeness of -2.

The predicted mass of the Z^+, 1,530 GeV/c^2, is very low, and it happens to fall in a region where there had been no experimental searches for S=1 baryons, primarily because kaon beams previously used in such searches did not go down to sufficiently low energies. Therefore, the new prediction provided virgin territory for a new particle search. Taking up the challenge of these new theoretical predictions last year, a Japanese experimental group used the gamma ray beam of the 8-GeV Spring-8 electron storage ring facility, located in Kamigori, Japan (not far from Kobe) to produce a reaction between 1.5-2.4 GeV gamma rays and the neutrons in carbon nuclei placed in the gamma-ray beam. They expected that if the hypothetical Z^+ particle existed, it might be created in the gamma + carbon reaction, along with a K^- meson.

I should emphasize that this experimental undertaking was a bit of a long shot. Many experimental groups in particle physics have conducted searches for hypothetical exotic particles predicted by theorists, and very few of these searches are ever successful. The Japanese experimenters were therefore amazed to find that their data contained strong evidence for an S=1 particle that broke up into a K+ meson and a neutron and that made a mass peak at 1,540±10 MeV/c^2, essentially on top of the mass-energy that the theory had predicted for the $Z^+(1530)$ pentaquark. They triumphantly announced these results in a paper published in the journal *Physical Review Letters* on July 4, 2003.

Subsequently, an American experimental grout at the Jefferson Laboratory in Newport News, Virginia, used the tagged-bremsstrahlung gamma ray beam of that facility with the CLAS spectrometer to reproduce the Japanese measurements, finding the mass peak of an S=1 particle, assumed to be that of the $Z^+(1530)$, at a mass-energy of 1,543±5.0 MeV/c^2. The pentaquark had been discovered, and the discovery had been verified independently.

The discovery of the pentaquark has started a veritable "gold rush" among particle-physics experimental groups, many of whom are now combing over the data from past measurements, looking for evidence of pentaquark particles among their old results. The prediction of the $\Xi^-_{3/2}(2070)$ should be particularly interesting in this onslaught of experimental searches, because it should decay into two negatively charged strange particles, a kind of breakup that no 3-quark baryon could have.

Okay, so what have we learned? The pentaquark may be a new form of mat-

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ter, but it is not stable. It only lives for a short time before it breaks up into more conventional particles. Moreover, the new results, it should be emphasized, do not "break" QCD, our standard model of particle physics. Instead, they extend QCD in an interesting new direction, and perhaps provide a new theoretical technique (chiral solitons) that may be able to predict structures beyond the pentaquark that may form exotic particles.

One physicist compared the discovery of pentaquark particles to the equivalent situation in biology, where living organisms are usually classified as either plants or animals. The pentaquark would therefore be analogous to the discovery of a new organism that had both animal and plant characteristics.

As mentioned above, the strangelet baryon, composed of two or more up-down-strange quark triplets, is another could-be state of QCD that has never been observed. In a recent column entitled "Quark Stars" (*Analog*, November, 2002), I discussed astrophysical evidence that neutron stars, when they reach a certain mass, may collapse further to form quark-matter stars, composed of equal numbers of up, down, and strange quarks that are not enclosed in a "bag" by color confinement. A quark star would be the extrapolation of the strangelet configuration to very large numbers of quarks. The existence of the pentaquark gives this strangelet scenario in astrophysics more credibility.

We have found a new state of matter, but it is an exotic and short-lived one that may have few implications for the everyday world. It represents another demonstration that the Universe is stranger than we imagined, with structure and complexity that we are only beginning to understand and appreciate. ■

AV Columns On-line: Electronic reprints of over 118 "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available on-line at: http://www.npl.washington.edu/av. Electronic preprints of papers listed below are available at: http://arxiv.org.

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What men really want is not knowledge, but certainty.

—Bertrand Russell

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DRAFT DODGER'S RAG

Jeff Hecht

"The grass is always greener . . ."
can mean many things.

"So how bad you wanna get out, man?"

Tom was too stoned to focus his eyes on the guy. They'd been sitting in the fat hippie girl's room all night, smoking her dope and listening to her records. The guy looked kind of Chinese in the dim red light. Straight long black hair and scraggly thin beard, like Ho Chi Minh's but dark.

"Real bad," Tom said. "Burned my induction notice. Would go to Canada, but don't have the bread."

"I'm goin' to the moon, man. I'm gonna stay up there 'til the war is over," the kind-of-Chinese guy said, a stoned, round-faced Buddha.

Tom was too far down to be that high. "My best buddy Mike enlisted right outta high school. Damn fool in the Marines. Turned him into a monster. VC got him. My old man called today."

"Oh, shit, man. Oh, shit." The kind-of-Chinese guy groped in a little leather sack hanging from his belt and pulled out a card. "I think this is it, man." He squinted at it. "I picked it up on campus. You need it, man." He handed the card to Tom.

Words were printed on the card, but the light was too dim for Tom to read them. He moved it back and forth and breathed in the sweet marijuana smoke, and decided to look at it later.

The record changer dropped a new album on the turntable. The Grateful Dead. The kind-of-Chinese guy leaned back, listening. The fat hippie girl was on a mattress in the corner balling the bearded guy who had cooked dinner. Tom put the card in his pocket, and fished for a piece of Zig-Zag to roll another joint. He couldn't find the paper and when he leaned back to relax on the old rolled floor mattress, he fell asleep.

The kind-of-Chinese guy was gone in the morning when Tom woke up, his head echoing from another dream of his father yelling "Get yourself out of that damn mess!" The fat hippie girl was snoring buck-ass naked on an open

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sleeping bag, her granny dress on the floor. The bearded guy lay beside her on the bare mattress, without his pants. Tom's head hurt. The clinging odor of smoke couldn't hide the foul smell of the dirty room. Allergies blocked his head solid. He looked for anything that might be his, patted his shirt pocket and felt the kind-of-Chinese guy's card.

Tom read the poorly printed words in light seeping around the window shades. "SAVE YOUR ASS FROM TRICKY DICK'S DRAFT." It gave an address on Telegraph. In the dim light, the apartment looked ugly. The war was uglier. Time to get up; time to do something. Tom found his old work shoes in the mess on the floor and slipped quietly out the door, toward Telegraph.

Tom wandered into a hole-in-the-wall lunch counter and looked at the prices on the board. The best he could get for his crumpled dollar bill was a cup of black coffee and two greasy donuts. The skinny girl behind the counter wished Tom "Peace." A plastic flower was stuck in her greasy blonde hair.

"Peace," Tom said as he picked up his tray, wishing it could happen. He sat in a booth and listened to two guys at the next table argue about Marx. Grad students. Philosophers. Philosophy had messed him up. The professor had kept asking questions he didn't want to think about, not after Mike had come back from 'Nam on summer leave to boast about killing Gooks. About firing a machine gun into the night and hearing them scream and die when the bullets hit. The nightmares came when Tom went back to school, messing his head up so bad he couldn't think. Math gave him problems for the first time, and he couldn't focus on astronomy. Smoked a lot of dope to ease the pain, and flunked flat out.

Hanging around Berkeley beat going back to the Chicago suburbs, and Tom had the money that was supposed to have paid for the rest of his sophomore year. When his father found out, he had called Tom an idiot for dropping out, and asked if he wanted to end up like his uncle Tom. When Tom called home after the money ran out in June, his smart-ass sister had said his draft notice had come and that he'd better get home or the FBI would come and get him. He had told her to go fuck herself and hung up. One of the guys who shared the apartment helped Tom find a part-time job in a bakery that paid for food, dope, and his share of the rent. Tom shuffled on, barely noticing Neil Armstrong walk on the Moon.

A newspaper in the seat said it was Wednesday. Maybe it was Thursday now. He found enough change in his pocket to buy another cup of coffee and asked the girl. She thought it was Wednesday because the owner always cleaned the booths early in the morning.

Tom stared at the headlines about the war. It was an ugly machine, coming to crush him. He'd already passed the physical. Should have faked something, but he couldn't work up the energy. The induction date had probably passed.

The wall clock said 11:15. He pushed the cold, half-empty cup of bitter liquid to the center of the table. The grad students were talking about Che Guevara and Phil Ochs, but the rebels, the singer, and the students couldn't stop the war. Nobody could. Time to move, Tom thought, as he stood, tuning out the grad students' words, and walked out the door, toward Telegraph.

The thick paint on the door was cracked and the window glass was dirty. Behind the lettering "Draft Aid Center" and "Crazy Haze Comix," stairs led to the second floor over the run-down hardware store. Small letters on the glass invited him to "COME IN," so he turned the knob and the door squeaked open. Worn black rubber mats covered creaky stair treads. The comix place was dark, but a light was on behind the "Draft Aid" door. Tom opened it and shuffled in.

A woman sat at a desk. A gray-haired

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woman, maybe his grandmother's age. Small and straight and stern, like a teacher. "My name is Marie Hruska. May I help you?"

"Got a draft problem. Guy said you could help." Tom reached into his pocket.

"That's what I'm here for," she said, motioning him to sit down.

"What's your status?"

"I don't know. Got an induction notice a while ago, but I burned it. Everything else is back home."

"Where?"

It was taking a long time for the grass to wear off. "Back home. Back in Illinois. Chicago suburbs."

The woman asked his name and address, and wrote something on a sheet of paper. "You're not in school?"

"Flunked out of the university," Tom said. "End of first term. Kinda lost track since then."

"What have you done since then?"

"Hung around. Didn't want to go back. Had some bread, found some crash space, worked a bit." Tom looked at the woman. Her eyes drilled through him. The coffee hadn't helped much. His mind still wasn't working, like a car that wouldn't catch when he cranked the starter. It was October now; getting toward a year.

She asked more questions. Had he passed the physical? Had he refused induction? Was he sure the induction date had passed?

Tom nodded, shook his head, and shrugged. "I don't know. I just can't face this. My best buddy, I grew up with him, and he went into the Marines and went over to 'Nam and they made him a killer and now they killed him. I don't want to fight their dirty war. I don't want them to make me a murdering monster."

"That's sad," she said, then asked him about his religion, and if he'd filed for conscientious objector status.

"Tried. Didn't work," he mumbled. "I'm no Quaker, just a stoned Methodist who flunked philosophy. You try to tell them war is wrong, and they say what about fighting Hitler?" He shook his head. "I tried to say killing is wrong, and they said why? I spent a week writing a five-page letter quoting the Bible and Gandhi on turning the other cheek and nonviolence. I said my conscience wouldn't let me just follow orders like Adolf Eichmann. All they sent back was a form saying 'no.' Taught me the difference between law and justice." Tom shivered, chilled though Berkeley autumn was not cold for a Chicago kid. He felt bitter and crushed, like a sharecropper doomed to a lifetime in debt. Too many more questions, and he was going to split.

The woman looked down at the paper. "You poor boy. They have you in a bad place. How bad do you want to get out?"

"Bad," Tom said. "Real bad. Maybe I'll split for Canada. Wouldn't do any good to rot in jail as a draft resister. Nobody would listen."

"Have you ever been arrested?"

"Nope." Worried a couple of times when cops had walked by when he was stoned, but never got busted.

"Do you care if how you get out is legal?"

Nobody had ever asked Tom a question that way before. Was she an FBI agent trying to trap him? Talking to her was playing chess stoned and not knowing the rules. Were there women in the FBI? Did she have the shiny black shoes FBI agents always wore? He couldn't see her feet behind the desk. He hadn't done anything really illegal before. Just smoking dope, and everybody smoked dope. Maybe swiped a couple of highway flashers with some of the guys. He'd lifted some food from a store once, when he was hungry and broke. How honest could he be when he was trapped by a stupid, ugly system that wanted to send him to fight a stupid, evil war? "Not as long as I don't have to hurt anybody."

Her old teacher face tried to grin.

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"You won't. It's not really legal, but it's not really bad, and it can get you out."

"Okay." Tom didn't feel as relieved as he thought he should. This wasn't like anything he'd ever heard. Guys went to Canada or Sweden. They went underground, put sugar in their urine, faked bad backs, got jobs in defense plants, or paid somebody off. "What?"

"We have someone replace you."

"What?" he said again.

"Replace you. We can have someone go into the Army in your place, using your name."

"Never heard of that." Tom had heard of guys gaining fifty pounds or getting braces, plenty of other tricks.

"You're not supposed to know about it. Nobody in 1969 is supposed to know about it."

"Doesn't make sense. Any fool can enlist under his own name." The Army would pin a medal on the man.

"Suppose these men aren't here legally. Suppose they shouldn't be here at all, and don't want anyone to know they are."

"Wetbacks?" Tom couldn't see why illegal Mexican immigrants would want to get into the Army.

She shook her head. "No, these men come from the future, a couple hundred years from now. It's a better time, with no more wars. You have to believe that; it really can happen." Her words had the fire of belief, like the Movement people.

She was crazy. You dropped a couple tabs of acid last night, grandma, and you're still eight miles high. Nobody travels in time except in their head. Tom knew the paradoxes, but he kept quiet. Old lady probably was crazy, but he could hope. Men had walked on the moon, and that was supposed to be science fiction. With nothing left to lose and no other options, Tom was ready to try it. "Why?" he asked.

"They want to be heroes. They think war brings glory and makes them men. I think they're crazy. Our society up then thinks they're crazier than your society thinks you are. Sending them down now is a compromise, a way to let them do what they want to do, without hurting anyone up then. We hope they learn how bad war really is."

Tom shuddered. Mike hadn't said much about the war when he enlisted after high school. He said it was his duty, like their fathers fighting the Nazis, and Mike wanted to get it over with. Tom hadn't understood that, and he couldn't understand this. His father never talked about duty; he had said Hitler was evil and war was horrible. Men who wanted to go to 'Nam had to be really crazy, not just strange like Berkeley people. "Okay, ma'am. If they want to go, they can get their heads blown off. May be stoned, but I'm not stupid." He hoped she wouldn't ask him for money.

"Good. We want to help boys like you who can't get out any other way. You go see Juan. He arranges the substitutions." She wrote a note on the paper before her. "Here's his address. Usually he's there from nine until six every day. Tell him you saw Marie at the Draft Aid Center. Tell him what you told me."

Before she handed Tom the paper, she reached into her desk drawer. He was surprised when she handed him two dollars along with the note.

"Go get something to eat. You look like you need it."

Shaken, Tom took the money. He wondered how bad he looked and how dumb he had sounded.

A note at the apartment said his father had called. Tom trashed it, and was glad the mail pile had nothing from his parents or the draft board.

A shower helped clear his head; he stood under it until the water ran cold, then wrapped the towel around himself and walked down the dim hall to his room. He found clean underwear and a flannel shirt that wasn't too dirty. He was eating crackers in the kitchen when the phone rang, and he answered it automatically.

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"Tommy?" It was his father. "I called, and the draft board said if you enlist now they'll put you behind a desk. They need men who can type. It will be three years, not two, but they won't send you to Vietnam, and you won't have to fight."

"Fuck off!"

"Tommy, I don't want you to end up like my brother. If they draft you, you'll have to go—"

Tom slammed down the phone. He'd heard too many times about the dead brother his father had named him after. He wouldn't be a part of their war machine, even if he could stay safe behind a desk shuffling papers. Leaving the cracker box on the counter and a knapsack of dirty clothes on the kitchen floor, he stalked out. He walked down the hill, toward the bay.

Juan's address was an aging concrete block building behind a barber shop, with white paint flaking from worn gray cement. It had been an auto-repair shop, with two pairs of swinging garage doors, both locked shut, and a single white door marked "OFFICE." Tom knocked, and turned the handle when a voice invited him in.

A round-faced man with very dark hair and brown skin sat behind a gray metal desk in a surprisingly neat little room. A copy of *Life* magazine lay open before him. "Marie sent me to see Juan," Tom announced.

"That's me," the man said. "You got draft trouble, kid?"

Tom felt uneasy; the man looked Mexican, but his accent wasn't right. Maybe it was an FBI trap. He was glad he didn't have any dope on him.

"Don't be afraid, kid. Marie called and told me about you. She always does that."

Tom nodded. "Yeah, got draft trouble." Admitting it wouldn't hurt. Almost everybody had draft trouble.

"Okay. We may be able to help." His dark eyes appraised Tom. "Are you willing to vanish for two years? Just disappear? Nobody will be able to find you, and once you go, you can't change your mind."

It didn't sound right. "Canada?" Tom asked.

Juan shook his head. "You don't need us to go to Canada, kid. Hop a train tonight and you can be in Vancouver on Friday. If you're broke, go thumb a ride; you'll get to the border inside a week. Draft resistance isn't a crime in Canada; they won't send you back. But you're stuck there. The Feds bust kids who come back to their grandmothers' funerals."

"Marie said somebody would take my place." Tom tried to read the man's expression.

"That's right, kid. Somebody comes down now to spend two years in the Army under your name. When their tour is over, they go back up then and on paper down now you're a veteran, entitled to all the benefits thereof. It's not a bad deal. It's a damned better one than the Army will give you. You got a birth certificate, draft card, or ID?"

"Driver's license and draft card. Burned the induction notice." Rolled it up and lit a joint with it, but Tom knew better than to say that.

"The card is what matters. License doesn't have a photo, does it?"

Tom shook his head.

"That'll do. Uncle just wants bodies to fight; he doesn't care if they're yours. All you do is bring your papers back here, tell the substitute what he needs to know to pretend to be you, and zip into the machine. When you walk out two years from now, the substitute gives you his discharge papers and mustering-out pay, tells you where he's been, and you're off scot free."

Something didn't add up. Tom's mind grabbed at a question. "So where do I hide for two years?"

"Smart kid." Juan paused. "What did Marie tell you?"

"Time travel, mumbo jumbo, didn't make sense." Tom wanted to hear what

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the man had to say.

"It's not mumbo jumbo, kid. It's future technology. I was born in the year 2162 in Nashville. Up then, we've got technology that would look like magic to you. One bit of techno-magic is that we can send people back in time. We can't go back to exactly our own past; but your world is close enough that we don't get into trouble. You know why we come back now?"

Tom shook his head. The congestion in his nose still smelled faintly of pot smoke, and he didn't want to say something stupid.

"We know how bad war is, kid, and we've managed to stop it, but some crazy fools up then still want to play soldier. You've got the wars they want, so we send them down now. Slogging through a real war is good therapy; most of them get over it. You stay out of the war. Everybody wins."

"Why?" Tom asked.

Juan chuckled. "Sometimes I think you freaks are the only sane ones down now, kid. You're harmless. Your heads are messed up, but war would only mess them up more. We help you, and you help us. That's the way the world is."

Maybe the man was crazy, but Tom didn't want to go to war or to jail. "What do you do?"

"Find somebody from up then who can pass for you. It's easy in 1969; nobody has DNA profiles. Your friends wouldn't recognize you with a shave and a military haircut. What's your height and weight?"

"Five foot ten, one-fifty-five."

Juan moved the magazine to look at a sheet of paper on his desk. "We've got a few who can do you. Brown hair, brown eyes, medium build. Tom Jackson is a common name; nobody could track you down that way after the war. Black kids have it easier; they all look the same to Whitey." He chuckled. "You're in if you want it, kid."

"Where do I go for the next two years?" Tom worried that Juan was evading his question.

"You skip them, kid. We send you two years into the future."

"You're putting me on."

"You just pop in the time machine and walk out two years later a free man. Like you're in an elevator, kid. The doors close, you feel a little something funny, and the doors open two years from now. You think you spent maybe a minute going up then."

"Have you done it?"

Juan shook his head. "I came down now in it, but I can't go back up then until I leave for good. Once I go forward in this time line, I can't come back to now. It violates causality. You can only go forward, to a time where you weren't before. Don't worry about it kid; I don't. I stay here, down now. They pay well, and it's interesting. I've been down now almost two years; after three more, I head back up then, with a pile of money waiting. Don't ask me how the time machine works, kid. I don't know."

It sounded stark raving mad, but Tom had nothing left to lose. "Is that all?"

"You can't bring much gear with you. Just a pack you can carry into the time machine. We've got no room to store things. If you know anybody else who wants out, send them to Marie, but don't tell them what it is. They'd think you're crazy. Same thing for friends and family. Tell them you're splitting for a while, or enlisting, but nothing about us. They'd think you're nuts."

Tom nodded. It was better than waiting for the FBI to knock on the door. His parents deserved to worry for a while. "When?" he asked.

"Monday," Juan said. "Get here by 10 A.M."

Thursday night Tom missed a person-to-person call from his father. The operator left a note to call collect, but Tom ignored it. On Saturday, Tom told the bakery he wouldn't be back; the owner thanked him and gave him $40 cash in-

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stead of a paycheck. That evening, he told the guys in the apartment he was splitting. They knew better than to ask where. They'd watched him burn the induction notice, and they didn't want to know if the Feds came asking. He sold his sleeping bag and mattress for $20, and his cooking gear for $10. He told the guys they could have anything else he left.

Sunday morning his father woke him up with another person-to-person call. He was still trying to sell Tom on enlisting to be a clerk. "It's not fun, Tommy, but it's safe."

"They're lying to you. I won't be part of the war. I'm splitting."

"You're going to get in trouble."

Tom hung up. He'd let them worry while he was gone. They'd tried to run his life too long. That evening the guys offered him a farewell joint, but he turned it down for the first time in a long while. He wanted a clear head for the future.

Tom knocked on the office door just after 9:30 on Monday. Juan was there, and a tall black kid with wary eyes who introduced himself as Joe. Three white guys showed up together just before 10:00, looking stoned. The five sat nervously on metal folding chairs in the office while Juan went into the back of the building. The lights flickered as a high whine came from the back. Tom fidgeted until Juan returned with five more young men with very short hair.

One was black and tall. Three matched the other three guys, one short and blonde, the others a shade darker. The fifth had to be the substitute for Tom. Juan introduced them, and told them to sit down while he explained things.

"These guys are going to be you kids for the next two years. They need your paperwork; they need to know enough about you to pass muster. They don't need to know all your girlfriends, but they have to know your parents' names and addresses, when and where you were born, where you went to school, that sort of stuff." He turned toward the substitutes. "And you've each got note pads, so you write it down. No army down now will take you if you're too dumb to remember your mother's name. You want the sergeants to think you're smart as well as gung-ho. Make sure you memorize it all; that's why you don't go down to enlist until tomorrow."

Juan paused and looked back and forth between the two groups. He looked toward Tom's group. "Kids, these guys come from over 200 years in the future, so their questions are going to sound weird. They have to pass for you to the Army, but they will never talk to your families. If somebody writes a letter that reaches them, they'll ignore it. That's the deal. After they get out, they'll tell you what they did, so you don't sound like idiots when somebody asks you about the war."

He turned to the others. "Like they told you up then, down now doesn't have much in the way of identification technology, just photos and fingerprints. As far as we know, these kids don't have any prints or photos in police records. All you've got to do is learn a little about them, and look a little like them. The draft boards just want bodies; they don't care whose."

When he was done, Juan paired them off, and sent each pair to separate small rooms.

Claude was Tom's substitute. He asked eager, nervous questions in a voice with an odd accent. As he answered, Tom felt he was undressing himself, shedding details like clothing.

They got down to particulars. "No shop," Tom said when the questions turned to high school classes. "I was college prep. Wanted to be an astronomer. Didn't want to push paper like my father."

Claude looked up from his notes. "Why don't you want to go? You have

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the chance to be a hero. We have nothing like it in my time. We have no more heroes, no more wars, no more risks. There is no courage left in our world."

Tom stared at Claude, speechless. He had always preferred physics and math because the correct answers were always beyond argument. He knew right and wrong, but he didn't know how to debate them. He had wanted to eloquently denounce the whole war machine in front of the draft board, but the words had never come. He had no words for the depths of Hell he had seen in Mike's eyes when Mike talked about battles he had fought in.

"They told me you would be cowards," Claude said.

It was supposed to be an insult. Tom had heard it before; from Nazis dressed up as Marines, from aging cartoonists who were no longer funny, from the washed-up Borax salesman who was governor of California. It didn't matter. As his roommates passed around the joint he'd lit with his induction notice, they'd agreed they'd rather be live cowards than dead heroes of an evil war.

Tom looked at Claude and saw Mike's ghost. Claude would be a good soldier. March and follow orders. Kill and stand ramrod straight and salute, not *Sieg Heil* but Hail Nixon. Mike had not wanted to become a monster, but Claude did, and he scared Tom. Tom didn't want to kill or fight anyone. He wanted the war to end so everyone would leave him alone. Maybe that was how his father had felt about the Nazis. "Maybe," he said. "Maybe I am. Maybe we all are. You want our places, and we give them to you."

"It is a vital war, you know. I have read about it up then. The communists are evil. Don't you care?"

"I wouldn't make a good soldier," Tom said, not wanting to argue. He knew a thousand reasons to stop the war, but he knew Claude didn't want to listen any more than Mike had.

"I've trained for this, up then, but our military camps only play at war. I have to test myself in a real war."

"You're not afraid?" Tom had to ask.

"No. There is risk, yes, but a small one. We have a little to fear from your weapons, but there must be some risk for there to be reward. To be a man, you have to fight and risk death. That I believe. That we all believe. That is why we came down now."

Tom wondered why Claude was arguing with him. Was the replacement really trying to convince himself? He let Claude talk, but he didn't really listen.

In the end, when they had nothing more to say, Claude stood and shook Tom's hand formally, thanking him for the chance to be a soldier. Drained, Tom thanked the other man for going.

They were the third pair of men to leave the little conference rooms. Juan asked if they had finished everything, running through a list, and when he was satisfied pointed them to separate benches. Joe looked at Tom when he sat down, and whispered, "They're strange, man. They're really strange. This dude thinks he can't die. The Army's all about death, man."

"Yeah," Tom nodded. "Brainwashed."

"Must be," whispered the other. Tom smelled liquor on Joe's breath, but he sounded sober. "They don't fit where they came from. That's why they come back here. Weird guys."

Mutely, Tom agreed. They waited silently for the other two pairs to emerge. When all were done, Juan stood before them with a clipboard.

"The time machine will be ready in ten minutes. It looks like a small room with metal walls. You walk inside with the gear you brought. Nobody brought more than one pack, did they?"

His eyes swept the five as they shook their heads.

"Good. All five of you go at the same time. I close and lock the door behind you. It will be dark inside, completely dark. Don't try lighting a match; it can

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mess things up. You will feel vibrations for what seems like a couple minutes. When you get up then, it will be two years and five weeks from down now. Your replacements and I will be here to greet you. As soon as I open the door from the outside, it will swing open and you can walk out. We have to lock it for safety."

"Why we gotta be locked in, man?" one of the white guys asked. He sounded like he'd stayed up waiting for the Sun with a couple of joints.

"Safety," Juan repeated. "You're not in normal space and time when the machine is running. Everyone can get messed up real bad if anybody freaks and tries to climb out the door."

"I don't like it," the guy said.

"You want to go help Uncle in the rice paddies? Lots of other guys want to get out."

"Cool it, Frank," one of his buddies said. "It'll be okay."

Juan thanked him. "Don't split right away when you get there. You'll have a couple of years to catch up on."

Tom hadn't thought much about that. Two years would be 1971. More men would have walked on the Moon. His wise-ass sister would be in college. He wondered what would happen as he hoisted his pack and walked with the others into the metal box. Juan clanked the door shut and there was darkness and utter silence except for a hum that came from the shaking of the metal itself. He felt stuck in suddenly thick air, unable to move or talk, unconscious of breathing. The box pulled back and forth, floating, rising, falling, like a stoned elevator. Somebody screamed, and the sound echoed down corridors. Then the door opened, light blinded him, and off-balance, Tom staggered against the wall. The guy who had complained had fallen to the floor.

Juan held the door as they staggered out. As Tom's eyes adjusted, he realized the light was dim. Five people sat on folding chairs, but as they came into focus, he realized Marie was one of them. Joe's replacement was there, and three white soldiers, but not Claude. Tom looked around, but saw no one else.

"Welcome to November 21, 1971. It's debriefing time, kids. You soldiers need to tell the dodgers what happened. You dodgers, you need to pick up enough of their stories to pass for veterans. On paper you spent the last two years in the war. The briefing rooms are set up; the same ones you used before you left. We put note pads in the rooms, and you can have all the time you want."

He looked straight at Tom; two sudden years showed on his face, a dash of gray in the long sideburns that hadn't been on his face when Tom had left. Juan looked very tired, with deep circles under his eyes. "We've got to talk to you separately, kid."

Tom walked to the office with Juan and Marie. The room had aged; the walls needed paint, trying to remind him two years had passed. "Where's Claude?" he asked when they sat down.

"The damned fool got himself killed, kid." Juan put his hand over his face and sighed deeply. "It had to happen sometime. Some of them think they're immortal down now. He played hero, charging the VC, and they dropped an artillery shell square onto him. There wasn't enough left to put him back together, even up then."

Two years or half an hour ago Tom had talked to the dead man. He felt numb, but it was not like when he had heard about Mike. When Tom heard the sadness in his father's voice on the heavy black phone, he had known something was wrong. "We got a call from Mrs. Szczepanski," his father had said slowly, and Tom had known that Mike was dead. "I'm sorry, Tommy, but I had to tell you." His father was crying, and Tom had cried too. His father had started talking about missing his brother, and cried some more before Tom hung up, went back to his room and got stoned.

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"I'm sorry," Tom said, looking at Juan. "But lots of people get killed in 'Nam. Claude knew it."

"It wasn't supposed to be possible, kid."

"He must have known there was a risk, Juan," Marie said. "Nobody up then is immortal. They make all the substitutes coming down now certify that they understand the dangers. We had to do that ourselves. Remember?"

"Sure. But the nanos can heal all ordinary twentieth-century diseases, the same way they can fix up wounds that would kill anybody else on the battlefield."

Juan's words cut through the last wisps of haze in Tom's mind. Something the substitutes had brought from the future could save them from being killed in the war. "What?" he broke in.

The two looked at him, uneasily.

"You said something could fix wounds on the battlefield. What was it?"

The woman looked at Juan, seeming very shaken. "We aren't supposed to say anything about the nanos, Juan. Just let the dope-heads think they were off on another trip."

After a long pause, Juan turned toward her. "Does it matter? No technology down now can detect the nanos. We're clean."

Tom looked between them, climbing step by step through levels of uneasy dreams toward whatever passed for reality. It had been hard to sort reality from the dreams when his nose still pulled in ghosts of pot smoke with every breath. The only smell in the old office was stale air, harsh in his lungs.

Juan turned toward him. "Look, kid, remember we told you we came from the future. Up then, we've learned how to repair the body. Not just sew up wounds, but heal them. We have little synthetic cells in our bloodstreams; we call them nanos. Some stop cancer cells from multiplying; some clean up arteries so the blood flows smoothly. Some can build new organs to replace damaged ones. If a substitute takes a bullet through the heart, the nanos can rebuild the damaged tissue in minutes. Nanos in the brain fix up any damage from loss of blood. The substitutes wake up in ten, fifteen minutes, weak but okay, like they were stunned. In the thick of battle, nobody notices."

"You mean guns can't hurt them? Like they're only playing soldier?" Tom shivered.

"Not that simple, kid. The nanos can't put somebody back together if they're blown up as bad as Claude was. They are programmed so small wounds take a normal time to heal. We don't want replacements to look like supermen. Nobody down now is supposed to know about this."

"Then why are you telling him, Juan?"

"We owe it to him, Marie." He looked at her with obvious annoyance. "We were supposed to help him, and we screwed him up instead."

"I want to help him. This will only make things worse," she said.

"I want to know," Tom tried to get their attention.

Juan glanced at him, then turned back to Marie. "Look, this works because we take only kids the Feds won't believe, heads and stoners and black kids without much schooling. Remember back in June? The cops picked up some kid on a bad trip in the Haight, and he told them all about us. I played Mr. Clean, and showed the Feds the old auto parts in the back room, and said they better lock that freak in the nuthouse. By the time the shrinks get done, he'll think we were hallucinations." Juan turned toward Tom. "You're smart enough to keep your mouth shut and stay out of trouble, aren't you kid?"

Tom nodded. "Yes." It had all sounded too easy. "But if nobody's going to believe me, anyway, you can tell me more, can't you?"

"Okay, kid. We understand each other." Juan's eyes sparkled a moment.

Questions tumbled through Tom's

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mind. "Why do they come to fight in 'Nam?" he asked. "Why not some better war? Don't they want to fight against Hitler?"

"Some do, but there weren't a lot of draft dodgers in World War II. A few want to fight for Hitler, but we won't let them," Juan said. "Vietnam is so unpopular in America that it's perfect for us. How many of your friends wanted to go, kid?"

"One did. He killed, and he got killed." Tom wanted to cry, but he couldn't cry in front of them.

"The substitutes coming back say it's an evil war," said Juan. "But new ones keep coming for the action. Lots of men dodged the draft for the American Civil War, but the action is too slow for up then. They would love the high-tech wars in your future, but we can't make substitutions after the military starts genetic profiling of soldiers. Vietnam is the perfect war, kid."

Tom didn't understand what they meant by genetic profiling, but he wondered about the future. "Can they change what happens?"

Juan shook his head. "They can change some people's lives, and maybe affect a battle or two, but not who wins the war. That's a lot bigger then individual lives, kid."

"What about my life? What am I supposed to do now?" Tom asked.

"I don't know." Juan looked down and drummed his fingers on the desk. "Down now you're dead, kid. The government has closed the books on your life. The Army picked up what was left of Claude and shipped it back to Illinois, and your parents cried and buried the pieces."

"Couldn't they tell it wasn't me?"

"No. There wasn't much left, kid. The chaplain recommended a closed-casket funeral. We didn't find out until afterwards."

"Everybody who knew you thinks you're dead. You've got nothing left down now. We can send you up then, to our future," Marie offered. "It's a different world, but a good one. We've made peace with nature and each other. With the nanos, you can live almost forever. Look at me; I'm 134 years old. There's nothing left for you here."

"I . . . I . . . don't know." Tom looked back and forth between them. "Can I come back if I don't like it?"

Juan shook his head. "No, kid. Once you're up then, you can't come back down now in this time line. Otherwise you violate causality."

The woman glared at him.

Tom stared at them both. The reality hit him slowly. On paper he was dead; Claude was in his grave. His parents had already buried him. They must have cried over his death. Tom felt tears coming, squeezed his eyes shut, and put his eyes over them so the two wouldn't see. "Please let me think."

"We can send you up then right away, with the substitutes returning up then. It will be much easier for you," Marie said.

"Let him think, Marie," Juan said. "It's not much extra trouble to send him up then separately. Let's get the others out of here. We'll be back, kid. There's just two of us down now in the Bay Area, and we've got to do everything."

A chair scraped and two pairs of shoes trod across the bare concrete floor. The door opened and shut. Alone, Tom put his head on the desk and wept in silence, thinking how bad his father must have felt.

Someone knocked on the door. "Tom, you in there?" The knob turned, the door squeaked open, and Tom looked up at Joe. "What happened, man?"

"The substitute got killed. They buried him for me. Everybody thinks I'm dead."

"What you going to do?"

Tom started to shrug, then changed his mind. "Let's get out of here. They want to send me to their future, but I'm not ready to go." He grabbed his pack.

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"The old lady sounded really uptight. They rushed the other guys out and forgot I was in the john. They're sending the soldiers back in the time machine."

Tom shouldered his knapsack and Joe opened the door for him. The lights flickered and the time machine whined. They slipped out the peeling white door and walked down the alley. The day was cool and drizzly. They could see the changes two years had brought; the barber shop had become a variety store, and the other men on the street had longer hair and beards, but they didn't stop.

"I'm hungry. I'll buy you some lunch," Joe offered. "Let's go find someplace to eat and think."

They walked several blocks, saying little as they looked around, the drizzle seeping into their clothes. A newspaper in a sidewalk box confirmed it was November 1971. The war was still going. They came to the lunch counter where Tom had eaten before visiting the draft counseling office on Telegraph. The same blonde girl was behind the counter, but she didn't recognize Tom. Nobody would remember him after two years.

Tom ordered a hamburger platter, with fries and a soda. He was surprised to see Joe order a steak, rare. It had been a long time since Tom had bought anything but the cheapest items on the menu. Joe paid with a fresh twenty-dollar bill. It was mid-afternoon and the place was almost empty, but they took their trays to a booth in the back.

"Why would they send you to the future?" Joe asked after they sat down.

Tom's hamburger tasted good; he squirted ketchup on the fries. "Maybe to get me out of the way. The Army sent the substitute's body home, and my parents buried him. Everybody thinks I'm dead."

"So the Man can't come get you." Joe sliced his steak and chewed with enthusiasm.

"And I can't go back home, or I let out that I never was in the Army."

"Do you want to go back? Parts of my past, I'd be glad to lose. I'm tired of playing dumb for white cops. Maybe the future doesn't have bigots."

"I don't want to give up everything." Tom picked up a fry and bit off the ketchup-coated end. It wasn't perfect, but it was crisp and the ketchup tasted good.

"Me neither. Future's likely to be a weird place. Probably couldn't get a real beefsteak up there." Joe chuckled as he took another bite.

"Can't be much stranger than Berkeley," Tom said, looking at a fry with skin still on one side. "But they said there was no coming back once I went. All I wanted was to stay out of the war."

"It ain't my war, and I ain't going, that's what I said, Maybe I'd fight the Klan, but they ain't them." Joe said. "Now I got discharge papers, I'm free. I told the guy who went for me to take the medal back where he came from."

"I didn't get anything. I don't know what to do. Got no place to go. Maybe go underground, I guess." Tom wondered about Canada. He didn't know how much a train ticket would cost; maybe he could hitch.

Joe sipped his lemonade. "I guess I'm lucky. I told my uncle I was splitting, and he said I could stay with him whenever I came back."

"Guess I screwed up everything," Tom muttered. He felt sorry for his father. He'd buried his only brother, and now he thought he had lost his only son.

"You don't want to go to the future?"

Tom sipped his soda through the straw. "No," he said, thinking. "The old lady's crazy. She said she was 134 years old, and that I could live forever in the future. They do something to people so their wounds heal. Juan said that's why the substitutes weren't scared."

"She's crazy, man. People live longer than they used to, but not forever. The guy who went in for you got killed. If people can live forever, they would end

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up like her."

"I don't want that," Tom said. He could still feel her trying to pull strings to make him do what she wanted. Ideas tumbled through his mind. He wanted to tell his parents he was alive, but couldn't just go back home and say he'd never been in the Army. Canada should be more like home than the future, and he could call his parents from there. "I need time to get my head together."

"I know the feeling," Joe said. He cut another piece of steak and chewed slowly, savoring the red meat. His dark eyes looked into Tom's. He put down his knife and fork and pulled a thick envelope from his pants pocket. Tom stared when he saw it was full of twenty-dollar bills. "It was his mustering-out pay," Joe said. He peeled off some bills and pushed them toward Tom. "Take it."

Tom stared at the money. "I can't. It's yours."

Joe put the envelope back in his pocket, cut another piece of steak and shook his head. "It's really the other guy's, the guy who went in for me. Back in the little room where we talked, he handed it to me, and said 'You were right. The war was awful. Make this do some good.' I got my uncle in Oakland; right now you don't have anybody. You need it."

Tom looked at the money. The $60 in his pocket wouldn't take him far. The twenties would buy a ticket to Vancouver, and pay for someplace to stay. "I'll pay you back. I . . ."

"Don't worry about me. When the time comes, you help a brother."

Tom thanked him and picked up the money. When they were finished eating, he went back to the counter and bought them both cups of coffee and slices of apple pie with scoops of vanilla ice cream on top. Then they caught a bus to the Oakland train station.

The railroad cars were dirty, worn, and mostly empty; Tom was happy to sit alone and watch the country go by. He counted the money he had left; Joe had given him $300. It would hold him until he could get a job. Later he could try college again. Farms, forests, and mountains went by as the wheels clicked on the rails, calming him. After night fell, he dozed off looking at the stars.

The sky cleared overnight, and the morning Sun hit his face through the east-facing window. Thinking of his parents, Tom cried, but he felt better as the Sun rose higher. His mind felt sharp for the first time in months, and when he got up for a drink of water, he stuffed the little leather bag that had held his stash of pot into the trash.

At the Vancouver station, he stopped to get Canadian money on his way to a phone booth. He gave the operator his parents' number, and dropped coins into the slot. The coins dinged, distant metal switches clicked and clacked, and the phone rang. His father's voice answered.

"Dad, it's Tom. I'm alive."

The line was silent. Tom worried that his father might have had a heart attack, but after an age the reply came. "Oh my God!"

"I'm safe. I'm in Vancouver."

"It is you! Thank God!" came his father's voice across two thousand miles. "I'm sorry I gave you so much grief. I was worried because you were drifting. I didn't want you to get dragged into this awful war and killed like your uncle. This war isn't right, and you're my son. That's why I tried to get you a desk job. I tried that for myself, once."

With the haze gone from his head, Tom understood. "It's okay, Dad," Tom said. "I know I screwed up bad back in Berkeley, but I couldn't become part of the war machine, and I had to do it myself."

"That's how we learn, son. I hope someday we'll learn how to stop war."

"We will, Dad," Tom said, thinking of the time travelers. "It may take a long time, but we will." ■

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Storm Front

Larry Niven

Most folks enjoy a day in the sun, but some take it to extremes!

The dome that covers the Draco Tavern can be set to show almost anything. It can be a window. It can show recordings across the whole dome, or break up into dozens of frames. We can get live feeds from anywhere in this world or others. Moving among the tables on a busy night, I'm subjected to a bewildering variety of scenery.

Tonight's crew ran to sophisticates: aliens of a wide variety, but they all knew how to use the visuals to tell stories or back up arguments. Worlds danced around me, and obscene medical animations, and fractal geometries. This night had already run more than thirty hours since *Spin Constant*'s lander came down from the Moon. When I got back to the bar, I set the view to transparent just to give my eyes a rest.

The Sun was trying to rise, not quite making it in Siberian February; just enough to put a golden glow on the horizon. It washed out other stars, but the new star blazed brightly within the glow.

A Chirpsithra officer folded herself into a chair at the bar. I offered her a sparker. "We came to view that," she said, indicating the star. "It's already in its later stages, but we have good recordings. Ssss," as current flowed through her nervous system. "We saw the neutrino wake and were able to slow down for the best view."

"Is that footage available?"

"Surely, for a price."

We get newsfolk in the Draco Tavern. I'd drop the word.

Beneath the new star, a yellow-white light came rolling across the ice. I waved at it. "Is that one of yours?"

"Not a passenger," the chirp said. "A refugee."

The visitor rolled in like a big lamp, a five foot tall sphere glowing yellow-white, its intensity turned down now. It bumped along the shock-absorbing floor. It was heavy.

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That glow must be riding lights, I thought, so that passersby don't get rolled over. If that color had been blackbody temperature, the Draco Tavern would have burned. Nonetheless the sphere was hot. As it approached the bar I felt welcome warmth on my face. In Siberia in winter, you never quite get warm enough. Various customers, human and not, turned toward the visitor or expanded their surface areas. Others shied away, of course. The Tavern gets all kinds.

I asked, "What'll it be?" trusting the translator I was sure it carried.

"Only your company," the visitor said. "You don't store hot plasma, I take it. How strange this place is!"

"Compared to what?"

"Compared to my home. Let me show you." A tendril of light sparked on the thing's surface. In response, a triangular window formed in the dome, shedding blue-white light with whorls in it.

"Damp that," the Chirpsithra officer ordered. The light dimmed. Even so, it would put out a lot too much heat if it stayed on. I tried to guess what I was looking at. "One of those star-hugging gas-giant planets?"

"A sun. That sun." A sparkling tendril waved out at the brilliant pinpoint.

The pictures in my head turned over. I was looking at a containment for a plasma confined at X-ray temperatures.

A refugee, the Chirp had said. I said, "Sorry."

"There was a plague," the refugee said. "A self replicating magnetic effect that damps us from the inside. Before we could control it, there were only eleven of us left. Too few, far too few, to regain control of our weather. *Spin Constant* came in the last breath of time to save nine of us."

The Chirp said, "We'll be able to read out their memories with a few years of study. That won't sell to just anyone."

You can hear, and sometimes you can buy, peculiar nightmares in the Draco Tavern.

I flinched from increasing the refugee's pain, but he seemed willing to talk. I asked. "Weather?"

"The weather in a star can become chaotic, out of balance. Like that." Again the refugee gestured at the nova in Earth's sky. The sunset light had died, and it had become more brilliant yet, with shockwave patterns traced around it.

To the Chirpsithra I said, "That's too close for comfort, isn't it? Close enough to hurt *us*."

"We can sell you some shielding," she said.

"Good." Of course someone would have to explain this matter of cosmic rays and a ruined ozone shield to professional politicians in the United Nations. It would be like talking to handicapped children, but otherwise the funds wouldn't emerge.

I decided that wasn't my problem. I asked the refugee, "What will you do now?"

"We hope to settle in Sol, if the locals make us welcome."

"Sol?" *Our* sun. "Locals?"

The chirp was amused. She asked me, "Did you think the steady weather in your star was an accident? Most stars on the main sequence have a population that knows at least rudiments of weather control. Any telescope can tell you whether they do it well or badly. In Sol, they're a little clumsy. Bigger stars are harder to control. In their twilight years an intelligent species can lose their balance. Then there are novas and other disturbances."

I nodded as if I'd known that all along. "Would they, the locals, be interested in talking to us?" It seemed unlikely that they would visit the Draco Tavern, or come to this cold rock at all. But they'd have knowledge to contribute, and who knows? Human mathematicians and computers might contribute something their Weather Department could use.

The Chirp said, "I'll speak to them when we negotiate for Fireball," indicat-

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ing the refugee, "and his people. That won't be soon. We should quarantine them for a bit to be sure they're not contagious."

An anthropologist was signaling for a refill—gin and tonic, she being human—and I turned away to make it. But the word sat in my head like a time bomb. Contagious. Contagious?

Beings deep within the Sun, all dead of Fireball's magnetic contagion. How would we know? We'd never detected them when they were alive. The Sun a vast graveyard, sunspots boiling uncontrolled across the photosphere, X-ray-temperature storms forming deep within. Masses sinking toward the center, temperatures rising . . . the Sun rings like a great gong . . .

I asked, "How long a quarantine?" and turned around.

But the Chirpsithra officer and her fiery refugee had gone off to another table. ■

Chat online
with your favorite authors!

Gene Wolfe **January 13 @ 9:00 P.M. EST**
Chats about *The Knight,* Book One of the Wizard Knight series.

Legends II Chat **January 27 @ 9:00 P.M. EST**
Join Raymond Feist, George R.R. Martin, and Tad Williams in a chat about the new blockbuster anthology! One lucky chatter will receive a copy of the slipcased and gold-foil stamped limited edition, which has been signed by every author in the book.

Go to **www.scifi.com/chat** or link to the chats via our home page (**www.analogsf.com**). Chats are held in conjunction with *Asimov's* and the Sci-fi Channel and are moderated by *Asimov's* editor, Gardner Dozois.

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Promises, Promises

Mia Molvray

When the aliens arrived, they weren't what we'd expected. You never saw a more pop-eyed, friendly lot. At first, when all they did was watch everything with galloping enthusiasm, it was like being overrun by Labrador puppies. Later, when they decided we needed help managing things, some people worried. Most of us found the Oolians a welcome change from our usual leaders, so we didn't mind, but once the Incidents began, more people thought we had to get rid of them. However, getting rid of aliens with faster-than-light travel is easier said than done.

In our town, it started when Joe Biddle ran for mayor. You know Joe: owns the biggest car store in town. He's in the Rotary Club, the country club, and the Church League club. So Joe ran for mayor. He could've been selling that big car you've had your eye on, the one with the compass nobody uses in the rearview mirror and little windshield wipers on the headlights. The town, he said, needed a monorail. It would revitalize business and tourism. He was also going to help the homeless, improve our schools, and create a budget surplus. You know how politicians talk.

The voters didn't object. I mean, are you going to stand up and say, "Hey, Joe, I'd rather you didn't improve our schools"? Of course not. The Oolians loved it. You'd think they'd never heard a politician make promises before, they were so enthusiastic.

Joe's opponent never stood a chance. He was kind of serious, didn't look like he'd ever kissed a baby, even his own, and talked about the cadmium in our town dump. Nobody cared, except the fifty people living near the dump, and even in a town like ours, you don't get elected by fifty people.

So Joe was inaugurated as mayor, made sure the letterhead was changed in the city offices, put his photograph in the city buildings, and worked on his golf handicap.

After a year, the kids still didn't know where Mexico was, the homeless still lived downtown, and Joe's brother, of Biddle and Biddle, General Contractors, had won the bid on the monorail project. Everything was perfectly normal.

The Oolies looked like Labrador pup-

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pies who'd had their chew toys taken away. Joe had promised all these wonderful things, they pointed out woefully. What happened?

Joe Biddle explained that he'd been working tirelessly, day and night, but these things take time.

"Day *and* night?" asked the smallest of the Oolies. "You were playing golf last Saturday. And the office closes at five on weekdays."

"Seems like a lot of effort," said a medium-sized Oolie, "if it doesn't get you anywhere."

That wasn't entirely fair. That kind of talk had made Joe mayor, but that wasn't what the Oolians meant. However, they were willing to wait and see, so Joe carried on.

Three years later, when Joe's term was over, the city administration was up-to-date on its letterhead, the kids still didn't know where Mexico was, and the Oolians called a meeting.

They sat at the top table looking like Labradors who were rather closely related to wolves. "Did you or did you not make these promises?" the medium-sized Oolian demanded, verbally pinning Joe.

"Of course," Joe hastily agreed. "I've had some notable successes. Complaints about the homeless are way down."

"The homeless are still there," said the largest Oolian, who rarely spoke.

"Of course," said Joe, "but they're no longer a problem."

"They still have nowhere to live," said the smallest alien.

"But I gave them all dummy phones," Joe announced triumphantly. "Now, when they talk to themselves, it doesn't bother people."

The Oolians looked puzzled, shook themselves like dogs coming out of water, and moved on to the next phase.

"You have heard of the social contract?" asked the medium Oolian.

Joe nodded.

"You have promised to deliver services, others to pay for them, yes?"

Another nod from Joe.

"You have been paid?"

"Uh, yes." You could see him sweating, thinking he was going to have to give back his nice salary.

"Then you must deliver. Promises must be kept or anarchy results."

At first, it looked like they planned to lecture Joe to death, but city officials come with calluses on their ears, making them immune. However, the Oolians didn't stop at talking. It turns out that breaking the social contract is a serious crime on Oolia.

So there was Joe Biddle, facing an Incident.

They pointed this sort of pencil thing at him, and Joe became a changed man.

Now he has to keep his promises.

Last night I was driving home from the movies and saw him out there, digging holes for monorail pylons, all by himself. The school principal had to ban him, in no uncertain terms, from "helping" in the classrooms. The homeless don't like his soup. Nobody knows when he sleeps. And someone who has to keep his promises sure can't sell cars.

You wouldn't believe how this has changed the tone of elections. The cadmium guy is running again, and this time I think he's going to win. ■

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The UNCOMMON COLD

Jerry Oltion

This, in its quiet way,
may be a real-life horror story.
And *you* may be a character!

"I swear," Rita said, "if this damn cold doesn't get better soon, I'm going to . . ." She sniffed, coughed, then rolled her eyes toward the ceiling. She was curled up on one end of the couch with a book and a cup of tea, smothered in blankets and snuffling through a nose red from too much blowing.

"Going to what?" asked Greg. He sat on the other end of the couch, with his feet tucked under the corner of her blanket more for companionship than warmth.

She shrugged. "I don't know. Buy stock in NyQuil?"

"Ah," he said. "Probably a sound investment."

She glanced back to her book, then snapped it shut. "Did you know a cold used to last seven days?"

"So I've heard," he said. "But that's an average. Sometimes it takes longer for the body to repel the virus."

"Yeah, right," she said. *Sniff.* "When was the last time you were over a cold in a week?"

When was his last cold? Hadn't he caught one when they were in Colorado for Thanksgiving? That's right, because it had kept him from going to the Fraleys' Christmas party. Hmm. That had been a particularly rotten cold, hadn't it? Well, how about before that? He'd been healthy all summer, save for the obligatory chill that always knocked him out when the weather first turned warm. He always pushed his luck with shorts and T-shirts, and always paid for it. Last summer's cold had lasted a while, but he'd worked too hard in the garden, trying to get it ready for planting when the weather warmed up for real, so it was his own fault. And before that, the only cold he could remember was the one over a year ago that kept him from getting out and seeing the fall colors with Rita.

Fall colors lasted about a month in Oregon. Hmm.

"Okay," he said. "My last three were all long ones."

"I'd have to dig through my journals,"

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she said, "but I can't remember *ever* having a seven-day cold." *Sniff.* "They always take a couple of weeks to clear up." *Sniff.* "But everybody still says that colds last a week. Why is that?"

"Maybe we're just sickies."

Rita took a sip of tea. "It's not just us. Jordan's been in and out of work since Christmas. He keeps relapsing."

Their stockinged feet under the blanket were celebrating Valentine's Day at the moment.

"People shouldn't go to work sick," Greg said. "You wind up sitting all day next to someone who's sneezing and coughing cold germs everywhere. That's probably where you got it."

"Maybe," Rita admitted, "but Jordan's out of comp time. If he takes a day off, it comes straight out of his paycheck."

"That makes it okay?"

Rita shrugged. "You can't ask someone to lose a day's pay just because they've got the sniffles."

"You can if they give 'em to you." Greg felt a tickle in his nose and sniffed once himself.

"Very funny," Rita said. "And normally I'd agree with you, but Jordan's living from paycheck to paycheck. If he loses a day, he won't be able to pay his rent."

Greg supposed he should feel sympathy for the guy, but with Rita home all week, eating up comp time that they could have used for a vacation somewhere if she hadn't come down with Jordan's cold, Greg wasn't inclined to cut him much slack. Jordan should have budgeted part of his comp time for illness instead of using it all for trips to see his long-distance girlfriend. But it didn't sound like he was much good at budgeting.

"Why should his bad planning become our problem?" he asked. But before Rita could respond, he sneezed three times in quick succession.

She looked at him with arched eyebrows. "You okay?"

His nose felt tingly. The wrong kind of tingly. "No," he said, and he sneezed again. "Dammit, now I think *I've* got it."

Three days later he was sure. And ten days after that, five of them taken off work, he was in a tiny exam room, sniffling loudly and trying not to sneeze while a doctor young enough to be his daughter told him, "There's still no cure for the common cold."

"I know that," he said. "But my employer requires a note from a doctor if I'm off work for more than three days."

"Oh," she said, managing to put her opinion of his company's management into one syllable. She scribbled on a prescription pad for a full minute, then handed him the note. It said, "Please excuse Greggie's absence from work, but he has sensibly quarantined himself at home, as anybody with half a brain ought to do when they have a communicable disease." Her signature was an illegible squiggle, but the text of the message couldn't have been more clear.

"Uh, thanks," he said. "I think."

"I can't believe all the companies that want their workers to die in the trenches rather than take a day off now and then." She sniffed, then snatched a tissue from the box on the cabinet beside the exam table and blew her nose.

"Speaking of which . . ." he said.

"I've always got a cold," she replied. "I see a hundred patients a week with 'em; there's no way I can avoid it. I swear, sometimes I think if it lasts one more week, I'll . . ."

"I would think you'd eventually become immune."

She shook her head. "It doesn't work that way. You can only catch any particular *strain* once, but the cold virus mutates so quickly, by the next time you're exposed to one it's different enough to slip past your immune system."

"Is that why they seem to last longer nowadays?" he asked. "It's not just one cold, but several of them caught end-to-end?"

She paused with another tissue halfway to her nose. "Huh?"

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"Colds used to last seven days," he said. "Or so common wisdom would have us believe. But my wife and I have noticed that they last a lot longer than that anymore. Two weeks for a light one, and sometimes a couple of months before you shake a really bad one. Maybe it's because they're not just one cold."

The doctor's forehead wrinkled as she thought it through. "I don't know. It's a possibility. There's a hell of a lot more cold viruses out there than there used to be, simply because there's a hell of a lot more people for them to reside in." She blew her nose. "Hah. Maybe quarantine isn't the answer after all."

"Excuse me?"

"You quarantine people, you develop separate reservoirs of virus. If you mix 'em all up, the virus has to compete with other strains for dominance. At least some of 'em won't survive the competition."

Greg considered that for a moment. "But the ones that do would be nastier, wouldn't they? Most easily transmitted, best at infecting a new host, longest-living once they get established?"

She shook her head. "Not necessarily. A disease has to maintain a balance with its host. One that kills too quickly won't survive long itself. The optimum strategy for something like a cold is to infect its host without incapacitating him, so he'll spread it around as far as possible. Or failing that, to infect him for only a brief time, and move from host to host quickly enough that the population doesn't suffer. Either way, it wouldn't be deadly; just annoying as hell."

"Like we're seeing."

"The plural of 'anecdote' isn't 'data,'" she admonished. "But maybe you're onto something. We'd have to do a controlled study to be sure."

"Will you?"

That caught her by surprise. "I—I'm not really an epidemiologist. There must be dozens of people right here in town more qualified than I am."

"But. . . ?"

"But what?"

"You're supposed to say, 'But I'll look into it.'"

She shook her head. "Not with my schedule. Why don't *you* look into it? The CDC's records are public."

"The who?"

"Centers for Disease Control. They're a clearinghouse for medical information. Search their database for evidence of increased cold virulence in urban populations. Or decreased virulence. After all, we could be all wet."

She sneezed. A moment later, so did he. "What we are is all sick," he said.

He spent that evening poring over records downloaded from the internet. The CDC was just the tip of the iceberg; he found data on colds from researchers all over the world. There was way more information than he needed, and a lot of it was in cryptic medical jargon, but he was able to puzzle out the number of cases and the relative severity of them from records dating back over a century.

What he found didn't match his expectations. First off, the mortality figures were much lower nowadays than in previous generations. People used to die of colds. He remembered reading *Wuthering Heights* in college and thinking how wimpy Heathcliff and half the other characters were for dying of chills, but according to the CDC's records, Brontë had been reporting life as it actually was back then.

Nowadays colds still killed off the elderly on occasion, but hardly ever an otherwise healthy adult.

The data did support one leg of his thesis: infection time had definitely increased over the last few decades. Colds typically lasted seven days during the first years of data collection, but the average time was now eleven days.

I wonder how long colds lasted in our hunter-gatherer days? he thought. And how severe they were? Nobody's data extended that far back, of course,

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but logic dictated a certain limit. For instance, a person could only live so long without food. If the cold was so severe that the host couldn't hunt, then it could only last a few days before killing him. And like the doctor had said, a disease that killed its host too quickly wouldn't survive long itself. Greg guessed that a primitive cold only lasted three or four days, tops.

Rita came into the study to see how he was doing. She had gotten over her cold while he was coming down with his, but she had only been free of it for a week or so before coming down with another one. She stood in the doorway in her pajamas and bunny slippers, a blanket draped over her shoulders, and said, "So are we going to live?"

"Yes," he said, "and I think that's the problem."

"Come again?"

"Colds are getting worse because we keep living through them." When she didn't reply, he said, "They're evolving. Back in the days before modern medicine and central heating, a cold could kill you. The bad ones did. That kept them from getting out of hand, because the worst ones didn't let the hosts live long enough to spread the virus around. But now—"

"Now we take antihistamines and eat chicken soup and keep ourselves warm until we're better."

"Exactly. And we spread the virus around better now than ever before, because we keep going to work."

She laughed. "If we didn't go to work, we'd run out of money and wind up living under bridges, where catching a cold would kill us."

"Right." Now how did that fit into his theory? He didn't see it for a few seconds, and then he did. The chill that ran down his spine had nothing—and everything—to do with the virus currently calling his body home. "Holy shit," he whispered. "That's how it's going to end."

"What? With us dying of a cold under a bridge somewhere?"

He took her hand in his. He needed to feel her warmth. "No. That would actually be a good thing, evolutionarily speaking."

"Not for us."

"Right. But for humanity it would, because we'd eliminate our little reservoir of cold virus. If enough people died of this eleven-day strain, that would select for a less virulent strain. But it'll never happen. We've both got jobs. With two of us working, we can totter along like we've been doing, one of us working while the other one's sick, back and forth like that indefinitely. Other people will go on disability or start living off their pension plan until they can draw social security. *That's* how it's going to end: with everyone sick most of the time, but not quite sick enough to die."

She sniffed. "That's a cheerful thought."

"Uh-huh."

"You're tired and depressed. Come to bed. Things will look better in the morning."

"Yeah," he said. "I'll be right there." She went back into the bedroom. He powered down the computer and went into the bathroom to brush his teeth, but a sneezing fit hit him just as he opened the medicine cabinet, and by the time he got it under control he had to lean against the sink for support while he caught his breath.

He ignored his toothbrush and reached for the bottle of sleeping pills. He'd been taking one every night, the only way he could get even a couple of hours of rest, but tonight he rattled the bottle and wondered: Were there enough left for the cure?

It seemed pretty melodramatic to think of killing himself for the sake of humanity. He certainly wouldn't do it before checking his facts and his reasoning. Even then, he knew he couldn't do it out of altruism.

But if this damn cold lasted one more week . . . ■

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DISTANT FIRE

Richard A. Lovett

Making some things work takes patience and ingenuity.

The longest love affair in history was nearly two centuries old, but Fiona Newton didn't know it at the time. If she was aware of anything, it was a dream in which she again watched her youngest niece die—holding Tamara's cold, veined hand in her own smooth, warm one as her baby sister's last surviving child fought for one more breath, and then one more, and one more after that, until finally there were no more.

The funeral had been many years ago, but Fiona dreamed of it as though it were yesterday—as indeed it had been when she began the dream, which the outside world would perceive as occurring only in agonizingly slow motion: a barely perceptible squiggle of elongated brain waves, a heart rate that accelerated to two or three beats per day, lungs that drew a few shallow breaths each week.

She lay in a glass-lidded sarcophagus, surrounded by equipment that monitored her ultra-slow body functions and trickled chemicals into the blood inching so slowly through her veins. In the past, she'd been visited occasionally by doctors, but that had come less and less frequently as the life-support equipment proved reliable, until Fiona's most frequent guests were the technicians who gave the system its periodic check-ups, barely glancing at the dials that proclaimed her own unchanging condition.

At first, she'd also received visits from the press, with its love of follow-up stories timed for dates of significance only to editors in need of news pegs. "When's the last time we did a story on Sleeping Beauty?" someone would ask, and if it had been long enough, an editor would suggest timing the feature for Fiona's fiftieth birthday, or the thirtieth anniversary of her entry into the tank, or an anniversary of the most recent time she'd climbed out of it to walk the world of real-speed dreams. Or perhaps the editor would choose the one hundred sev-

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enty-fifth, one hundred fiftieth, or one hundred twenty-fifth year in the countdown before she hoped to return permanently to the realm of warmth and sun. Then another ambitious young reporter would visit—sometimes bringing the latest in high-tech telecommunications equipment, sometimes relying on the only medium that might outlive Fiona's slumber, the plain old-fashioned written word. He—the reporter was seldom a she—would gaze at the tresses that framed her face in Celtic fire. He would study the perfect complexion and toned muscles, barely altered from the dancer/singer/actress who'd once held the world in the palm of her hand, and if he had a heart—which he might be too young to have developed or already too jaded to remember—he would wish he could talk to the real person, rather than stare at the hardware-draped form of someone who by all accounts had once been one of the most engaging, beautiful, and *alive* people the Earth had ever known.

Then he would sigh and tell his audience about the equipment that sustained her. He would describe the month-long process required to wake her up and explain that a year to the rest of the world was but a few minutes to her. If he was medically sophisticated and had done his homework, he might even mention the auto-massage airbed that supported her still form so perfectly that on the rare occasions when she did awaken, she wouldn't discover that her entire body was bruised and stiff. Then he'd sigh again, this time about her contract with the hospital, which would keep the date of her next awakening secret until she was safely back in her glass sarcophagus, and he'd write an all-too-conventional feature to an audience that cared less with each passing year.

Then Fiona's niece had fallen ill, and the sarcophagus had barely managed to wake her in time to say farewell. After that, she had no more desire to step outside because Tamara had been her only remaining link to the outer world.

For many years she slept on, undisturbed except by the slow progress of her dreams. But eventually the big date came, when Fiona could awaken for good. By this time she had been asleep for so long that the last of the ambitious young reporters was long ago retired, and she lay forgotten as the sleep tank's AI brain—advanced by the standards of its most recent upgrade but aging by those of the society into which it was about to inject her—registered the news she was awaiting.

Wake-up drugs seeped into Fiona's blood. Her heart and breathing stirred beyond the levels of her dreams, and she began her slow return to the land of the living.

Ted was alive.

Ted was coming home.

Fiona and Ted had been the media darlings of the mid-twenty-first century. He was the hero of the United Nations Space Authority's first Jupiter mission, the man who'd single-handedly rescued his crew when a landing on Io, Jupiter's innermost moon and the most volcanic body in the Solar System, nearly got singed by an ill-timed eruption. Not only had he gotten everyone back aboard ship, but he managed to deploy an instrument package whose log of the event made a lot of scientists very happy. Ted was UNSA's golden boy, and had he been so inclined, he could probably have been elected to the UN.

Fiona was Hollywood's latest pretty woman. By the time she was in her early twenties, her clear, strong soprano had taken the music world by storm. Then, with the help of her own considerable talent and an agent with an impeccable eye for good roles, she'd proven she could also act by snagging two successive Academy Award nominations. The fact that she'd hadn't won either award was widely viewed as a snub: the holdover of entrenched beliefs that no-

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body that beautiful could truly have talent.

Fiona and Ted met shortly after his return from Jupiter. Breakthroughs in plasma physics were creating new space drives as rapidly as UNSA could build them, and Ted was already prepping for his next mission—a test run of a fusion drive that could go to Pluto and back in less time than it had taken him to return from Jupiter. He had no interest in meeting what he derogatorily referred to as starlets. Fiona was equally unimpressed with macho fly boys. As far as she was concerned, there was plenty to see and do on Earth. But UNSA and her agent both knew good publicity when they saw it, and Ted found himself maneuvered into escorting her to the premier of her latest picture.

If it wasn't love at first sight, it wasn't far off the mark. Ted and Fiona were a couple made in heaven, partly because each was so unimpressed by the other's fame that they could lower their public masks and be to each other things they'd never allowed themselves to be for others. They saw each other daily for two months, at the end of which they realized they knew each other more deeply than either had ever known anyone before.

Then the fusion drive was ready to boost for the outer System.

Pluto wasn't exactly the most interesting of destinations, so UNSA had opted for a yearlong journey to Saturn. By that time, Ted and Fiona were far beyond the stage the gossip columnists loved to call "an item." They'd even talked of marriage, but UNSA frowned on sending married men or women on long missions, so they said their vows to God and each other and remained officially single. Then Ted was off on his new voyage of discovery, adding to his and UNSA's mystique by bringing back samples of the planet's rings and leading a team to the ethane shores of its giant moon, Titan. Fiona made a new movie, a highly popular romantic comedy, but each day she and Ted found time to beam messages to each other. When he returned, it was as though they'd never been parted, only better.

After Saturn, UNSA had an even faster ship, and this time Ted really did go to Pluto. And again their romance grew, nourished by the fulfillment of their separate dreams. Pluto was followed by a couple of quick trips ferrying supplies to Mars while a different crew tested yet another high-powered drive on a start-and-stop jaunt through the Asteroid Belt. Supposedly the asteroid run was sampling the Belt for exploitable resources, but it was an open secret that it was a shakedown for the "big one" looming on the horizon: a manned mission to the stars.

By this time, Ted and Fiona's bond was also an open secret, and the world adored them for it, just as a century earlier it had adored another explorer, Charles Lindbergh, and the strong-spirited woman who sustained him. But there was one difference between Fiona and Anne Morrow Lindbergh. Although Charles was best known for his solo crossing of the Atlantic, many of his longest journeys were in a two-seater airplane in which Anne went with him as navigator and chronicler of their adventures. Fiona couldn't have accompanied Ted even if she'd wanted to. UNSA had no use for amateur astronauts.

UNSA now had a dozen fast ships plying the Solar System and ten times as many pilots, but Ted was so much the obvious choice to command the interstellar voyage that it was something of a surprise when the agency dragged its feet for nearly a year before offering him the command. Then the reason for the delay was revealed. Rather than going to a nearby star such as Alpha Centauri, as everyone had presumed, UNSA had chosen something bolder. Even for a short hop, it would take six months to get the ship up to speed, plus another six to slow it down once it got where it was going. But in the middle, when it was

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coasting, the laws of relativity meant that time would pass quickly for the crew, with little difference between the 4.35-light-year voyage to Alpha Centauri and a much longer journey. The economics of interstellar travel were such that if you were going to go at all, you might as well go somewhere *interesting*, and a much more interesting destination was a star 96 light years away that appeared to have Earthlike planets.

For the crew, it would be a two-year round-trip flight, with another twelve months to explore the new solar system. For friends and loved ones on Earth, it was different. The Alpha Centauri trip would have taken twelve years. This one would take 195. Everyone the crew knew would be dead long before they returned. Ted had been offered his deepest dream—but only at a terrible price.

Ted and Fiona talked endlessly, but she had watched what happened when he'd been passed over for the asteroid-hopping mission. He'd tried to dismiss it as "just a bunch of rocks," but she could read through him and knew he was pulled toward two shores: one by her side; the other dark, distant, lonely, and always, always beckoning—the bleak, starry fire that had forged the man she loved.

Their last night together was excruciating. Outside, the paparazzi circled, while within the five-star fortress of their hotel they tried to pretend it was an ordinary parting, or perhaps a birthday, anniversary, or other celebration of life and love. But of course it wasn't, and as the hours crept toward inexorable dawn, the charade broke and their tears mingled, until finally they clutched each other in silence, two motes clinging against an infinite universe.

If they could have willed the clock to stop, they would have hung forever in that suspended moment between space and time. But like the condemned prisoner awaiting execution—a fitting analogy for this separation that would be the end of all they jointly held dear—they couldn't avoid checking the time as it leapt in staccato bursts through a night that was simultaneously endless and all too swift. Then Ted brushed her cheek with the back of his hand and started to speak.

"Don't," she hushed. For there was one major difference between them and the condemned prisoner: a simple word could end it all—and if Ted offered to back out of the mission, she feared she could never let him go. And go he must, even though she would never understand the passion that drove him from the warm, green Earth she herself loved—any more than he could grasp the passion that forced her to don fictitious identities and hone them until they felt as real as her own. But one thing both had always understood was the passion of passion itself, and they knew that deprived of the fires that made them who they were, there would eventually be no true passion for each other, as well. How could she truly love him if she didn't want him to grasp the greatest opportunity that could possibly be handed to him?

And so, when Ted stepped from the hotel en route to the orbital shuttle that would start his journey, he went as the explorer, not the despairing lover. Only those who knew them best noticed that until the final moment, he and Fiona never once broke contact.

Fiona could have gone to UNSA headquarters to watch Ted's starship depart, but she preferred the privacy of home. At first, she could even speak to him on the phone, with only small delays between question and response. But the conversations quickly became out-of-phase messages as the speed-of-light delays mounted, first to hours, then to days and eventually to weeks.

As Ted drew ever more distant, Fiona poured all she had into her art. Her acting took on new intensity as she sought roles that allowed her to channel grief

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that wasn't really bereavement, heartache that wasn't really woe. The best roles were metaphors for her own anguish—private ones that were sufficiently abstract that only she knew how much of herself she truly put into them. She finally won that Academy Award, then added a Grammy as her vocals developed the depth and maturity of someone who knew the best and worst of life and how closely linked the two can be.

The work was an outlet, not a balm. Sharing who she had become stirred her soul as much as her audience's, and it kept her from bitterness—in touch with the world she truly did love. It did nothing to replace the loss that nourished her art, nor to stem the tears that stained her pillow when she lay beneath unshuttered windows on cloudless nights.

She and Ted had talked of life after his departure—what they would do when the time lag became so great that years would pass between message and reply. But it only struck home when she'd already won a third acting award by the time he could congratulate her on the first. Now, she remembered, they'd promised to move on—to desist in the long-distance correspondence that merely accentuated their separation. "I always knew you were the greatest," that time-lagged message said. "Now, let go of me and live."

That had been their agreement. A year or two to adjust, and then they would attempt to treat this living death as though it were the real thing. Reluctantly, she sent no more messages. She allowed a male costar to escort her to a premier. Cameras clicked and tabloids wrote unkind words. Fiona didn't even bother to read them because that one highly public "date" had proven what she privately suspected. Life after Ted was simply life. The costar was dashing and pleasant, but she would not attempt to *act* her way through a romance. She could live the life she'd chosen, but she wouldn't pretend she'd not made the choice.

Always she wondered about Ted. Was he happy, journeying to that distant sun? Had he heeded her advice any more than she'd heeded his? His crew was small, but had its share of eligible females. In particular, there was a Russian exobiologist who'd make him a good match. In the months when the departure had seemed safely in the future, she'd even teased him about who he'd pair up with, but she'd never quite found the nerve to mention the Russian. Now she wondered how long it would take him to notice her. Three years might not be long enough. From Fiona's point of view, they'd already been separated for longer than that, but his memory still burned as strongly as the stars she refused to block from her bedroom window.

It was sometime around then that she knew what she had to do. Money was no obstacle. Along with the acclaim, she'd amassed a considerable fortune—enough that she barely dented it when she decided to endow an entire research wing at a famous hospital. The only condition was that some of the money must be spent seeking ways to reunite her with Ted.

Initially, she'd expected to find the answer in life-extension, but that was a long, slow battle, in which two new infirmities cropped up every time an old one was beaten back. And rejoining Ted as a decrepit bicentenarian wasn't exactly what she had in mind, even if it was possible. He'd simply get to watch her die all over again. Cloning and cryogenics were also dead ends. Within months, she'd settled on hibernation.

It took the better part of a decade, but she could wait, and it was during these years that her art reached its greatest heights. Then, finally, the sleep tank was ready—and startlingly, her feelings were ambivalent. Far off in the future, Ted beckoned—presuming, of course, that his spaceship hadn't malfunctioned, that he hadn't fallen afoul of the multitude of

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mishaps that could afflict any voyage into the unknown. Presuming that he'd not actually united with the Russian exobiologist. Presuming that the sleep tank would actually *work* for humans as well as it appeared to for rats, dogs, mice, and monkeys—that she wouldn't simply grow old in it while sleeping away what was left of life. Prototype tanks had produced some very ancient and apparently healthy mice, but who knew what would happen to a human over a time frame measured in decades?

And she was still in love with life. She had friends and family who would miss her—who she too would miss. Climbing into the sleep tank was an enormous step—nearly as devastating as it had been to watch Ted's jump-suited form step into the maw of that long-ago shuttle. But she'd been to her own stars and it was time, if possible, to welcome Ted back from his.

Luckily, she didn't have to make the commitment all at once. She chose to limit her first "jump" to six months, after which she spent a year in the land of the living, even making one final film and a last, soul-filled recording: a celebration of love, loss, faith, and renewal that was her parting gift to her world. Meanwhile, the scientists fine-tuned the sleep tank. Her next nap lasted two years, followed by only a month's "vacation," this one spent entirely with friends and family. Then came a series of ever-longer jumps, with ever-shorter interludes until the final big one that ended only when her AI picked up the news of Ted's return.

Ted's starship had been the first to launch, but not the first to come back. The engineering race to create always-more-powerful drives had abated but there'd been a new launch every few years, including the belated journey to Alpha Centauri. About half of these beat Ted back to Earth, with stacks of scientific data, but nothing truly world-shaking. Still, Ted's return drew considerable attention.

Fiona's long vigil, on the other hand, had faded into history. Even the people at the hospital were shocked when she emerged. Pursuant to orders from the trustees, her private sanctum hadn't been disturbed during the hospital's periodic remodelings, but only the trustees had any idea what lay behind her door, and most of *them* viewed it as a sort of private mausoleum for their eccentric benefactor.

Much as she'd dreamed of this day, Fiona hadn't really thought through what she was going to do when it arrived. Perhaps, subconsciously, she never truly believed it would. Or perhaps she'd spent so much of her life so thoroughly hounded by the press that she'd never contemplated what it might be like to be forgotten. She could simply present herself to UNSA, or whatever it had become, and demand to see Ted. Most likely, that would work. But after all she'd been through, it seemed so *ordinary*. She wanted that first meeting to be special.

And, truth be told, she really was worried about the Russian exobiologist. If Ted actually had started a new life, she didn't know what she'd do, but she wouldn't complicate it by magically reappearing.

The solution proved as simple as it was old-fashioned. With the help of her sleep tank's AI, she located a politician—a WorldGov senator with strong space-authority connections—who was facing a tough reelection. After a brief consultation between her sleep tank's AI and his office AI, she offered him the equivalent of a million-dollar campaign contribution in exchange for entry into a reception honoring the returning astronauts. There was nothing all that odd about the request, and the politician—who wasn't the only one using the reception as a fundraiser—happily accepted the donation. Some things hadn't changed.

* * *

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The reception started at 7 P.M., but the explorers didn't arrive until two hours later, during which time nobody spoke to Fiona except waiters with offers of food or drink. When the astronauts finally stepped into the room, they were a small huddled group amid a sea of humanity among which they no longer truly fit. It even showed in their attire. WorldGov had equipped them in the latest fashions, but the starship crew wore the unfamiliar garments awkwardly, like self-consciously donned costumes rather than real clothes.

Some of the astronauts had clearly paired into couples, and the Russian exobiologist was indeed standing close to Ted. But her body language said that Fiona had won that gamble. The relationship hadn't progressed beyond the level of friends and teammates.

Fiona's million dollars had gotten her into the banquet hall, but that was all. Several hundred people were crowded between her and Ted. But she needn't have worried. She'd barely started moving toward him when he froze, staring at her across the shoulder of a pompous-looking woman who'd managed to be the first to pump his hand.

Eyes locked on hers, Ted shook free of the handshake, of other hands patting his shoulders, and of the supportive knot of his companions. He stepped her way like a man stumbling toward a distant beacon. He took another step and another, and then Fiona was scrambling across the room toward him, shoving people out of the way to throw herself into his stunned arms. "Is it really you?" he gasped, and she answered with a kiss that was better than words.

"But how?" he murmured before she smothered him with another kiss. Then, a moment later, "Is there anyone else? My parents? My brother?"—and she was forced to find the words to tell him that only she had cut her own roots to launch herself through time to find him again, and that she was oh, oh, oh so happy she'd done so.

And then the stunned silence that had greeted their reunion shattered as people consulted their AIs and finally figured out who she was, and the room exploded into bedlam.

They were the biggest story in the history of space exploration. Much bigger than the mission itself, which had found a few interesting planets and some pond scum that was the first conclusive evidence of extraterrestrial life, but no alien intelligences or cute-cuddlies to excite the media.

Ted and Fiona were feted, wined, dined, globe-trotted, and interviewed until they'd said everything there was to say a thousand times and more. At first it was all a grand vacation—an opportunity to gape at two centuries of technological progress. But soon they tired of playing tourist. For a while, Fiona tried to work, but the art she'd perfected had become an anachronism. Movies were sensory-immersion affairs in which characters were entirely computer generated. Most of the music that she could truly *feel* had moved into the realm of folk music—charming tales of a world gone by, which had to be explained before you sang them or the audience would miss the point entirely—and even then, Fiona suspected that people were more interested in her own novelty than in the songs themselves. Newer music was littered with incomprehensible cultural references, and the only call for real actors came from a remnant of live theater, where most plays presented the same problem.

Learning the facts of the new culture was easy—biochemists had long ago cracked the tricks of memory, and bookstore-style shops offered memory-transfer modules that would instantly cram your head with the most astounding arrays of information. These modules would teach her more than she wanted to know about how the new technologies worked, but they couldn't teach the nuances needed to convincingly interact

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with them before an audience that took such miracles for granted. Fiona could find work, but instead of satisfying her, each performance left her feeling diminished. She who could once sculpt audiences to her will had become mediocre.

Ted fared better. Space travel was still space travel, and while ship/pilot interfaces had changed wildly, the changes were of the type that could be taught via modules. And Ted had one proven, invaluable skill. The fire of exploration still burned within him, undimmed and undimmable. If Fiona was willing, he would launch again into the void while she waited in an upgraded sleep capsule in which the years would flick by with incredible speed.

This time, the decision was easier. Fiona had already given up her old life. It was irretrievably gone, and this new culture had no new stars for her to seek. Maybe the next millennium would be better. If not, she and Ted would be going there together, and when all was said and done, that was enough.

And so they surfed through history, each trip longer than the one before, punctuated by the brief, intense flickers of reunion. But always it was the same: in each new culture, they were merely sojourners with that single rare talent that propelled them again and again into the future.

Eventually, the inevitable happened and Ted's ship drifted lifeless through the unearthly beauty that had finally claimed him. Fiona's capsule now resided in high Earth orbit, where she could slumber undisturbed, awaiting a wake-up cue that this time would never come. But even her latest self-repairing machines couldn't last forever. Status lights flicked amber and then red until, in a slow ending that mirrored her life, Fiona was reunited with her love. If she dreamed during those final moments-stretched-to-eons, it was of what she'd told all who'd asked on prior reunions. She had lived, loved, made the right choices, and had no regrets. ■

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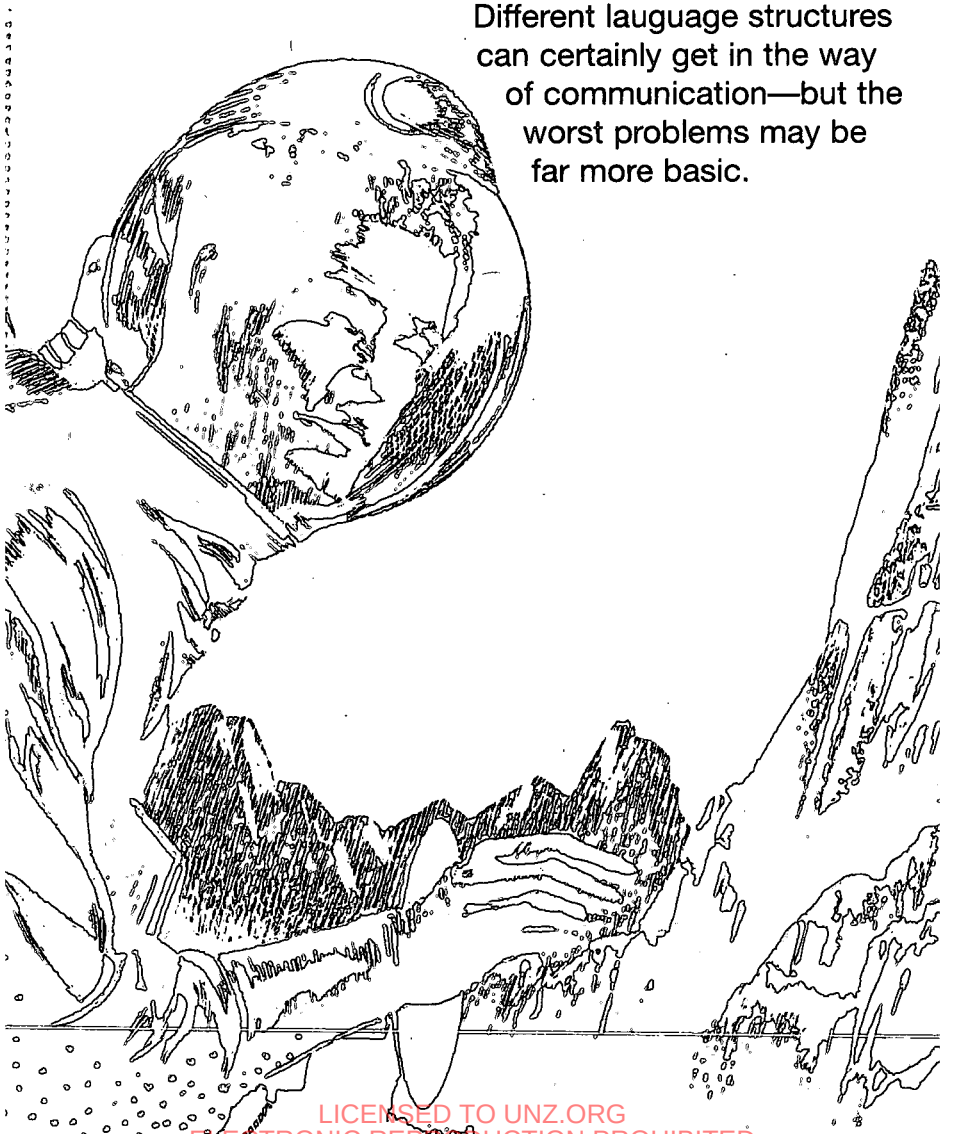
The Color of Pain

James C. Glass
Illustration by Vincent Di Fate

Different lauguage structures can certainly get in the way of communication—but the worst problems may be far more basic.



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"I didn't request your presence on Alysia, Mr. Skinner, and quite frankly I don't want you here. I don't need a diplomat. What I need from Portos is a good biochemist who can analyze the toxin the Worms are using against us, and develop countermeasures. Our people are *dying* out there, sir. We have a right to defend ourselves."

Commander Bern Plueger tossed the diplomatic pouch chip carelessly on his desk, and frowned. Cameron Skinner frowned right back at him, irritated by the man's attitude, the stifling heat, and the smell of rotting jungle vegetation that permeated the metal hut.

"You do not have the right to systematically destroy a sentient species for any reason, Commander. The law is clear, with precedents going back to cases on a dozen planets over three hundred years. If our presence is incompatible with the safety and survival of native, sentient species, then we must remove ourselves from the planet."

"Whoever told you the Worms are sentient is speculating," said Plueger. "It doesn't take a higher brain to build mud towers, but it seems that everywhere we can plant our crops the Worms have to build their structures. Without the crops, without the land, our people are back to the poverty they had on Portos, and I will not let that happen. If the Worms kill us, we will kill them until we are safe. It's that simple."

"Not until I establish a dialog with them, or become convinced they're not sentient."

"And in the meantime I'm responsible for your safety. I'd rather send you back to Portos on the next ship out."

"The governor will respond by returning me more millions of miles with a detachment of troops to enforce the law, if that's what you want."

Plueger glared at him, tapped a stylus rapidly on the desk top, then, "I've seen people die from wormspray: men, women and children. You can't imagine the horror until you've seen it. I'm not letting you into the field without an environmental suit."

"Fair enough," said Cameron. "I'd like to get started in the morning."

"A volunteer will accompany you. She's waiting for you in your hut right now. Except for sleeping, you will never be out of her sight. Understood?"

"Yes, Commander."

"Good. I have other duties now, Mr. Skinner. If you have to see me again, and I hope you will not, then make an appointment with my adjutant. A cart is waiting for you outside, and your baggage has been taken to your hut. You have only one week, sir. That's what your orders say. Not much time, unless you're only here to justify closing this settlement, but please try to stay alive."

Plueger waved a hand in dismissal, and turned back to his computer. "A linguist, of all things," he mumbled, and shook his head.

Cameron turned on his heel, puzzled, then left the stifling interior of the hut and squinted at orange sunlight outside. Sweat ran into his eyes, and his loose-fitting shirt was sopping in the armpits. The odor of the air was a combination of rotting garbage and sour body fluids.

The settlement consisted of three dozen polymer-sided huts shaped like half-cylinders cut lengthwise. They lined both sides of a soft dirt road running off in two directions into a jungle of tall, tubular-leafed conifers and an undergrowth of man-sized palm fronds and ferns. There were no bird or animal sounds from the jungle, only the grumble and whine of an electric generator surrounded by a short wall of cinder blocks topped with charging batteries.

An electric cart with an awning was waiting for him, driven by a twelve-year-old boy who called himself Dolan and complained about the recent absence of cooling rain.

The drive was short; at the edge of the settlement they stopped in front of a hut painted battleship gray. A woman

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stood in the doorway, expecting them. She had brown skin, black hair tied in a single long braid down her back, and she was dressed in white smock and pants. She extended a hand as Cameron approached the doorway, and he shook it.

She smiled nicely, showing snow white teeth. "I am Rabi Sen. Welcome to Alysia, Mr. Skinner."

They went inside. There was a frame bed, table, chair, and a standing closet. The metal floor creaked when they walked on it. Sunlight came in through a single window, and a bare light tube hung from the ceiling.

"It's simple, but you'll only be sleeping here," said Rabi. "Most of your time will be spent in the field, or my laboratory, you see."

"Ah, you're a scientist."

"Yes. We've been studying the Worms for nearly a year, my colleague and I. I will introduce him to you. We've made progress, but I fear we're running out of time. The Worms have become dangerous. Many of our people will kill them on sight, if allowed to. You've been brought here to prevent that."

"The law is clear on the destruction of native, sentient species," said Cameron.

"Ah, but we don't know they are sentient, Mr. Skinner. We have only the suspicion of it."

Cameron frowned. "The letter to the Governor's Office on Portos said specifically that the Worms are highly sentient, with a well developed social structure and communication skills, and they are responding to what they perceive as a threat against them. I'm here to open a dialog with them."

Rabi twisted her hands together, and looked straight into his eyes. "That will take time, Mr. Skinner. Their social structure might be no greater than that of some insects, and we have only a few vague ideas about how they communicate. We'd hoped for a team of scientists to speed our work, but Portos has sent us a linguist instead."

Cameron's face flushed red. "I'm both a linguist and a diplomat, Ms. Sen, and I have served on ten planets. Believe me, I've communicated with species stranger than intelligent worms, and—"

"The letter to the governor was mine," said Rabi, "and now you're here as a consequence of my distortion of the truth. I only wanted time to save the species from extinction, and move this settlement totally away from their habitat, but it seems they are everywhere, you see. Everywhere we must plant, the Worms must live."

"So the letter is a lie. Commander Plueger was correct. I'll contact Portos immediately, and have myself recalled before the shuttle leaves. I intend to press charges, Ms. Sen. You have wasted the time and resources of your government."

Rabi grasped his arm. "Please *listen* to me. Commander Plueger gave his approval of my letter. He shares our suspicions about the Worms. With you here as the governor's representative, he can now openly enforce the law regarding sentient species. It is an unpopular law with the planters, and he's under terrible pressure to destroy all the Worms. He doesn't want to lose the settlement over an uprising. Surely you know the governor feels our operation isn't cost effective. Portos would close us down over the slightest provocation. Please! Your presence gives us time to prove sentience and find a communication channel. How much time have you been given here?"

"One week," said Cameron.

Rabi gasped, her suspicions about the regional governor on Portos now confirmed.

The cart bounced hard in and out of a rut. Sitting in the back, Cameron hung on grimly to an awning strut. "How far out do we have to go?" he asked through clenched teeth.

Lael Dowd was driving, Rabi seated next to him. Chemist and zoologist, the

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two of them had spent the morning showing him their laboratory, photographs of Worms, and a model of the structures he was about to see. The sun was high, the heat oppressive, but inside the refrigerated environmental suit Cameron felt comfortable so long as he remained seated. Walking was another matter. The suits were like a layer of extra flesh, but stiff at the joints. Sounds from outside were variably amplified, so controlled communication was by radio, and Lael spoke too loudly. He was a small man, short and wiry and energetic. "Half a klick and we stop. It's another two hundred meters on foot to Wormtown, but the Worms can be anywhere, so keep your helmet locked and your gloves on. It would be bad form for us to lose you your first day out."

The road ended where they stopped. Lael activated the locator, sending out pulses at sixty kilocycles. "It's the law," he explained. "Security wants to know where every vehicle is, and why it's there. If we're not headed back in an hour, they'll come after us."

Even with micron-size filters, the jungle stench was palpable inside the suit. The trail was more a line of bent fronds and ferns overhung with cylindrical leaves the size of a man's body. At night the leaves unfurled like great sails to capture dew. The ground was soft with trampled vegetation, and made walking sluggish, so it seemed a long time before they climbed a shallow hillock and peered beneath a rotted, moss-covered log lying at the summit.

And Cameron beheld a city of the Worms.

At the base of the hill the jungle had been cleared away across a circular area a hundred meters in diameter. A shallow dome of glistening red earth rose several meters above level ground, and was topped with several chimneys large enough to swallow a man. The black maws of four tunnel entrances were visible, and Worms came and went, huge things the size of a large dog, bodies wrinkled and glistening in a flickering rainbow of primary colors that changed by the minute, now red, then green, yellow, blue. They moved more like caterpillars, though no legs were visible. Many were partially erect, holding vegetation in mouths shaped like parrot beaks as they went into the tunnels. A few moved over the dome more slowly, leaving behind a thick, glistening trail of transparent material.

"The vegetation is both food and building material for them," said Lael. "The structures are a composite of earth and a polymer they make in their bodies. They add a catalyst, that clear liquid you see going on now. Once set, it's hard as concrete and sealed against the weather. One hell of an insulator, too. I've run a lot of tests on the stuff."

"They're nearly finished," said Rabi, "and they only started this a few days ago. Wormtowns go up fast, and can be abandoned overnight."

"So close to the settlement?" asked Cameron. "I thought they avoided humans."

"They did at first, but then there was a Worm attack on a little girl at an experimental farm. A group of planters retaliated and flamed a structure like the one you see here. Killed every Worm. Confrontations have escalated ever since, usually one person in tall grass or thick foliage. Commander Plueger has moved the settlement twice to avoid them, but now it seems like the Worms are following us. They started construction here only days after we arrived."

"And there are five other structures underway around our settlement. It sounds paranoid, but this time I think they're surrounding us," added Lael.

"You mean war?" asked Cameron.

"Any sentient species that is attacked and feels threatened will fight to survive, Mr. Skinner," said Rabi.

"Perhaps, but look how slowly they move. If they're truly sentient, they'll get as far away from you as they can."

"If they let our settlement expand, the

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day might come when they can't get far away from us."

"Okay, then maybe they're building before you have a chance to plow up the ground for planting. They're establishing territorial rights."

Lael tapped him on the shoulder. "We can't live long in these suits. Filters clog fast, and we come out for air and food. All they have to do is move in close some night and fill the air with their neurotoxin. We'd all be dead in a minute, covered with our own mucus and vomit. I personally don't want to die that way."

Cameron watched the ponderous labor of the Worms, and was inclined to disbelieve what Lael and Rabi had said, but that inclination disappeared only half an hour later when they returned to their cart and found it covered with white powder, the locator still beeping merrily away.

"Oh, oh, look sharp," said Lael. He and Rabi crowded in on Cameron and pushed him away from the cart. "Don't touch anything. We've been sprayed."

Lael went to the cart, opened a panel, took out a cylinder with an attached hose and nozzle. A spray from the nozzle turned to icy fog; he sprayed the entire cart, then his gloved hand. "Liquid air kills most of it. We'll wait a few minutes, and sunlight will do the rest."

Cameron's head swiveled as he looked for movement in the foliage, and sweat beaded his forehead.

"Don't worry, Mr. Skinner," said Rabi. "This wasn't an attack, but a warning, and probably for your benefit. We've been coming out here since the Worms first started work. They know we're just watching them, but you're someone new."

"Are you trying to say they see us, and can distinguish between different humans? I didn't see any eyes on those things. Do you?"

"Oh, they see all right. We just don't know how, yet," said Lael. "I have some ideas about it if you want to listen."

"Okay," said Cameron. "I'm listening."

They talked about it all the way back to the settlement.

Commander Plueger was waiting for them in front of Cameron's hut.

"Sorry, but you'll have to remain in quarters the next day or two. There's been another attack, northwest, Plot Eighteen. A young boy is dead. Planters flamed the Worm, and are looking for its nest. I've sent police, but it might be too late to stop them. Give me some answers, people, and quickly! Communicate, negotiate, whatever, but get me a cease-fire before the Worms are flamed to oblivion and the governor of Portos uses it to close this one settlement where his poorer citizens can obtain free land for a new beginning in their miserable lives."

Plueger took the cart keys from Lael, and drove it away.

"He's angry, and scared," said Rabi.

And passionate, thought Cameron.

"Yeah, but he thinks we'll win in a war," said Lael.

Cameron thought it, too, but didn't say so.

"The colors are also important," said Lael. "There are two pits on the head, where eyes would give depth perception. I've found two kinds of cells layered on the sides and bottom of the pits. Neither respond to pure optical wavelengths, but I get output for the large ones in the near IR and the teeny cells put out sharp pulses in the low UV range. My squid measurements show axon conduction in the forward brain area between the pits."

"That's similar to our own sight, in some respects," added Rabi.

Cameron looked through the microscope, comparing cell samples on two slides. "So they do see us, then, and communicate through color patterns in their bodies. I could begin with a color generator to detect and return what they transmit. If they're as sentient as you believe, we should be able to build

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a vocabulary, and start communicating."

"I think it's not just the colors, but the patterns. You'll have to reproduce the patterns," said Rabi.

"Charge-coupled detectors will give us—"

"There's more to it, I think, maybe a lot more," interrupted Lael. "There's scent, and perhaps charge. That's your work, Rabi."

Rabi blushed. "Sorry, but it's so preliminary I wasn't going to mention it yet."

"Scientific caution is fine, but I need to hear *anything* that might help me communicate with these things," said Cameron.

Rabi looked at both of them, then brightened. "All right, but we don't have synthetic models for any of this yet. Just behind the sight pits there are porous regions with multilayered membranes that become conductive in varying degrees when exposed to things such as ketones and esters. I think they're scent detectors. Lael has isolated seven different proteins from the membranes so far."

"If I can find the right substrate," said Lael, "I can incorporate these proteins and synthesize an odor detector, but I've just started work on it. There are good models using carbon atoms in polymer layers. Carbon absorbs an odor molecule, swells, changes membrane conductivity."

"They might even detect sound, or electric fields," said Rabi. "There are two different kinds of fine hairs on their backs, but we haven't been able to—"

"Look, this is all interesting, but preliminary. I can see why you wanted a team of biochemists, but you got me instead, and I have one week, and that's not even time enough to get approval for an extension. Do whatever experiments you want, but first get me a color communicator I can use while suited. If the Worms know we're trying to talk they might not be so hostile. We have to start there."

"I can cobble that together in a couple of days," said Lael. "Then what?"

"Then I walk up to the Worms, and say hello," said Cameron.

Lael and Rabi looked at him with wide eyes, surprised.

The whole thing weighed fifteen pounds, camera and screen strapped across his chest, the powerpac on his lower back. The halogen lamp was hand held, with a color filter wheel in red, green, yellow and blue.

Rabi and Lael smiled at him through their faceplates, amused by his appearance. "You look like a large copy of a child's spacetoy," said Lael.

"It doesn't have to be pretty if it works," said Cameron. "Watch my back. I'll have all I can do to see what's going on in front of me."

They were nearing the top of the hillock overlooking Wormtown, and all three were still shaken by the morning's confrontation.

They'd left Cameron's hut at dawn and found a group of sullen planters surrounding their cart. Some were armed with shredders, the smooth-bore weapons that could clear a thousand cubic yards of underbrush with a single shot. The group had parted silently, allowing them to load their gear and climb in, but then a large, swarthy man, stinking of old sweat, had stepped in front of them, hands on hips, and scowled menacingly at them.

"You the ones studyin' the Worms?"

"Yes," said Cameron. "Portos has sent me to talk with them, and stop the trouble you've been having."

"You wanna stop the trouble, just help us kill 'em all," growled the big man.

"Can't do that, Earl," said Lael. "It's the law. You kill more Worms and we'll have Portos troops here. You want that?"

There was grumbling in the group, then curses as Earl said, "Didn't see troops here after the buggers killed my only son."

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"What you gonna do? Send us back to Portos to beg in the streets?" asked another man.

For a moment Cameron had thought the planters might tip their cart over, but the rocking ceased when Plueger pulled up and got out of his vehicle with the biggest nightstick Cameron had ever seen. Plueger punched Earl hard in the gut with it, ordered the planters to disperse, and they did. Then Plueger turned to the three of them huddled in the cart, and said, "Now get out of here," and they did.

That was the start of the day. "Good luck," said Lael. He and Rabi sat down on the rotted log at the top of the hillock. Their helmets were closed up and locked. Below them, Wormtown was active and glistening with a new layer of weather sealant laid down by its workers. Cameron counted twenty Worms out, moving slowly over the domed surface as if polishing it. He plunged down the hillock as slowly as he could, but kept slipping in the thick carpet of soft vegetation. Near the bottom he sat down hard on his rump. A nearby Worm jerked half its body upright, and seemed to look at him. It opened its mouth to display a circular array of small, sharply pointed teeth, and let out a soft hiss like an exhalation of breath. Its long body suddenly rippled in a color band pattern in red and green.

Cameron froze, then turned on the camera and played back the color pattern on his chest screen. There was no immediate reaction from the Worm, except to close its mouth. The other Worms paid no attention to Cameron, and went about their business, but this one closest to him kept its upper body erect for nearly a minute, flashing ripples of color, turning its head this way and that, perhaps looking for movement. Finally it went back to work, resuming its slow crawl across the red earth, and leaving a glistening trail behind it.

Cameron's heart thumped hard; he'd forgotten to take a breath. "Well, they know I'm here," he said softly, but there was no answer. He got down on all fours and crawled slowly out onto the dome of Wormtown, pressing down with his hands to test the surface ahead of him. "Hard as rock," he said. "When I press down, the whole surface springs back a bit, like I'm crawling on a thin slab."

"The dome might be hollow. We've never been inside," said Lael.

"Well, that tunnel entrance looks large enough to accommodate me. Let's see how far I can get." Cameron waited for a Worm to pass, then crawled towards the dark opening twenty yards ahead in a bulge by one of the chimneys. Other Worms came near, but only one lifted its body, writhing a bit, then holding steady as Cameron played back its own color pattern. "When I show them their color pattern, they seem to accept me, but they're checking something else, too, and it might be motion."

Cameron waved an arm. The Worm ignored it, and went back to its work. "It could be checking scents, or electric fields. Whatever it is, the Worms don't seem concerned," said Lael.

Near the tunnel opening he leaned against a chimney base and listened. "Vibrations here, and a moan. There's air going in or out of the chimney, a lot of it. And I can see some grit blowing out of this tunnel up here. There's a positive pressure in this thing."

"I really don't think you should go in there," said Rabi.

Cameron kept crawling. Two Worms came out of the tunnel and stopped, raising their bodies like cobras preparing to strike. One faced the tunnel, and its body was suddenly a shivering pattern in violet and red. The other faced Cameron, its body deep crimson. The camera recorded both patterns, and returned them to the Worms. Suddenly there was confusion, Worms moving past him at surprising speed and crowding up together by the tunnel entrance.

"Pull back!" cried Lael. "They're at-

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tacking you!"

Cameron looked around. Several Worms had drawn nearer, raising their bodies, but now held their positions. Five Worms were at the tunnel entrance, heads swiveling, clearly watching each others' color patterns, but seeming confused. Cameron slowed, then stopped. The patterns changed, the violet in them fading, then gone, but the red pulsing faster and faster.

"Back away; there's nothing behind you," said Lael.

"No. I'm waiting here until they commit to something. Will this suit hold if they all spray me at once at this range?"

"A good question. We should test it sometime, but not now."

Cameron kneeled, hands on legs, and the screen on his chest displayed a dancing pattern in red and some green. "I'd think they would have done it by now. It's like they're waiting for instructions. I'm staying here."

Lael groaned. "Too late anyway. More Worms just moved in behind you. If they start spraying, just get up and run."

"Right," said Cameron. It was getting warm in the suit, and he breathed deeply to still his heart. He heard a sound, like the snapping of small twigs. The Worm facing the tunnel entrance suddenly turned and flashed a pattern in green and red. Other Worms drew back from him, and those at the tunnel entrance went inside, their bodies pulsing green.

Cameron hesitated. "Worms still behind you. They just backed off a bit," said Lael.

"I think they want me to go inside." Cameron moved closer to the entrance, looked back. The Worms stayed where they were.

Rabi and Lael disagreed, and started to argue with him. Cameron crawled up to the tunnel entrance, looked inside. Wide enough to fit into, dimly lit, it forked into two smaller tunnels descending left and right. "I'm going in," he said. When Rabi and Lael yelled at him together, he tapped his helmet pad and shut off the radio. "Just doing my job, people," he said to himself.

Blessed silence. He crawled into the tunnel several feet, a kind of foyer four times his girth and a yard high, but the two branching tunnels were barely large enough for him to fit into. He peered into both of them, saw only blackness, lay still for a moment and listened.

The sudden sound of twigs snapping startled him. It came from his right. He turned on his side, looked down the tunnel there and saw a pulsing, green glow. The screen on his chest returned it. The glow changed to blue, then red, then lobes of primary colors strobing hypnotically.

Something rattled. The glows disappeared. The tunnel was dark again.

"Okay, my turn." Cameron held out his lamp, dialed a blue filter, turned it on a second, then off, a second, then on. Repeated the sequence in green, then red. Waited long seconds.

A bright spot of green appeared below him: on for a second, then off, repeated three times, and there was a sound like sandpaper rubbed on soft wood.

Cameron could barely control his excitement, and his mind whirled. *What now? Anything to show I'm trying to communicate.*

He switched the filter to green, sent a long series of flashes of equal length, then two quick flashes. What came back to him was two quick flashes followed by a pulsing blue glow so bright it illuminated the tunnel. Cameron squinted, and saw something move down there as clicking sounds came back to him. There was a thick, musky odor in his suit, and he wondered if it was his own nervous sweat or from outside. He answered with two long pulses with the blue filter, frustration building.

"Okay, we know we're trying to communicate, but what are we saying?" The sound of his voice was flat in the suit. He reached up to the helmet pad to turn

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on the radio, and—

There was a loud explosion—from outside the tunnel. A sharp rattling noise came with darkness, and scratching on earth below him. The walls seemed to close in; he pushed himself backwards, and nearly dropped the handlamp into the tunnel. Something rubbery and rough crawled across the back of his legs as he came out into daylight. Around him was chaos, Worms flattened out and crawled like snakes with amazing speed, their bodies flashing ribbons of red and violet.

Another explosion, very close. Cameron stood up, saw a man coming towards him across the glistening dome. He carried a shredder, reloading the double breech with new shells. He stomped a booted foot on an already dying Worm. The animal flashed deep purple as dark fluid ejected from its mouth. It was the man who'd accosted Cameron back at the settlement. He snapped his weapon closed and shot another Worm at point blank range, splattering it and red earth for yards around.

"Stop it!" screamed Cameron, but knew his voice was totally muffled by the suit. He waved his arms and charged at the man, horrified to see the gun raised until he was looking down two large bores and the man was grinning crazily at him.

The world was suddenly white as snow, as if a sheet had been pulled over his head. He stumbled on something and fell flat. Worms slithered away from him in every direction, and a heavy form crashed to the ground only feet away. Arms flailed the air, heavy boots beating a tattoo on the earth. The man's face was purple, and his mouth foamed. In seconds he was dead, eyes bulging.

The white cloud dissipated rapidly. The Worms were gone, except for the smashed bodies of three. Two suited figures rushed up to him, grabbed him under the arms and hauled him to his feet. Lael slapped the side of his helmet hard.

"Why did you turn off your radio? WHY?"

They dragged him off of Wormtown and back to the cart, only to find that the battery had been ripped from it and thrown away. Lael called Plueger, and told him what had happened. A cart was sent for them, and four troopers left behind to patrol the road near Wormtown.

Word about what had happened got around fast. By the time they returned to the settlement, a crowd of angry planters was already milling around in front of Plueger's hut.

The four of them sat around a table in Plueger's office, sipping tea while waiting for their evening meal to arrive.

"I have to go back tonight. There's no more time. That mob out there can't be controlled forever."

"What can you do in one night? We need weeks, not hours," said Lael glumly.

"Why can't I get you to believe I'd established the basis for communication when that gunman showed up?"

"So the Worms are good mimics," said Plueger. "That isn't communication."

"I don't think it was a Worm. It was black and quick, made rattling and scratching sounds. It didn't just mimic what I did, it changed color and flash sequences. We had no vocabulary to work with, but I'm convinced the Worm, or whatever it was, knew I was trying to talk. I think I already understand some things: green is safe communication, maybe also blue, red is caution, violet is fear, and purple is the color of pain. I saw it all in the Worms today. I can use this, but it has to be tonight before the planters get a chance to attack Wormtown."

Cameron looked directly at Plueger, and said, "If you allow them to do that, I'll immediately recommend to the governor that this settlement be closed and moved off Alysia."

"I'm not surprised to hear you say that," said Plueger.

"The planters are poor people," said

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Rabi. "They came here for land."

"They'll fight," said Lael.

"That's not my problem."

"No, it's *my* problem," said Plueger. "For a diplomat, Mr. Skinner, you're a bit quick to use threats."

Cameron blushed. "Maybe that's because I came very close to being killed by one of your own people today."

"We're talking about three hundred and fifty good people here, not one man. I have twenty men on the road outside of Wormtown, another twenty patrolling the road and a dozen more here in town. The planters are not going anywhere I don't want them to. You'll have to find another excuse to close us down."

Cameron bristled. "Why do you keep saying that? I'm here to communicate with the Worms. If you have problems with the governor, I haven't heard about them, but if he wanted this settlement closed down I *would* know it. So help me here. I have three days left. What's the problem with taking me back to Wormtown tonight?"

"If the planters see you leave, they'll want to follow you. Word is you'll defend the Worms even when they kill people, and I don't need a riot right now."

"They don't have to see us leave," said Cameron, and then he told them how it could be done.

Just after midnight, twenty troopers finished their tour on road patrol and went back to their barracks. Twenty replaced them, and left the settlement crammed into four carts a few minutes later. By that time most of the protesting planters had either become tired enough or drunk enough to go home to bed. The men and two women left in the road paid little attention to the rotating guard unit. There would be a news update in a few minutes, and so they crowded in front of Commander Plueger's hut to hear it.

Cameron, Rabi and Lael were bundled up in military fatigues over body armor and sealed helmets. They traveled in separate carts. At the end of the road they changed into environmental suits and hooked Cameron up to his equipment. He carried two handlamps, one with the color wheel to which he'd added violet and purple. A smaller wheel went on his helmet, Lael's newest toy, a circle of twenty chips of carbon impregnated polymer for sensing odorous molecules, and operated by microwave. Rabi added a microphone with its own transmitter. With screen and camera he was now carrying ten extra pounds. He used it as an excuse when a trooper offered him a handweapon, and he turned it down.

When the helmets were sealed, Lael batted him lightly alongside the head. "If you turn off that radio again, I will personally come out there and turn it on for you."

"Keep the talk to a minimum, then. Sound is another variable I don't need when I'm trying to communicate with these things, and the microphone should pick up only the sounds *they* make."

Under the trees and heavy foliage it was pitch black, but the sky was filled with stars providing light enough to see movement and general shapes in the clearings. Cameron's lamp shot a diverging beam that softly illuminated the trail ahead. The two hundred yards to Wormtown seemed like two miles. Behind him the feet of Lael, Rabi and two troopers made squishing sounds in the decaying vegetation.

They went straight to the log on the hillock summit overlooking Wormtown. No movement was obvious. Cameron dared to use his lamp, casting a soft glow over the dome, the chimneys, the black maws of tunnel entrances. Not a single Worm was out; there was no sign of life. The bodies of dead Worms had been removed.

A sudden sound broke the usual silence of the Alysian night. It was like

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sticks rattling together, and came from the jungle behind them. "Did you hear that?" asked Lael.

"Yes. Come down with me, and stay by the edge of the dome. I want them to see we're together."

They half walked, half slid down the embankment. Cameron turned on his color handlamp, dialed it to green and began flashing pulses towards the tunnel entrance he'd penetrated that day. Scattered light dimly illuminated the dome in front of him. He walked out a few steps and knelt there. The green light strobed for several minutes, but no Worms appeared.

"They're afraid of us," ventured Lael, "but I'm still hearing clicking sounds from the trees, and not just in one place. It's getting louder."

"Hold still," said Cameron. Whatever had communicated with him inside the tunnel was now outside in the darkness, and he was pretty sure it was *not* a Worm. He risked a test of his color theory, and dialed his lamp to violet for several pulses, then back to green.

The response was immediate. Rattling sounds came from the tunnel entrance, and a soft, flickering glow in green. Two Worms came out of the tunnel and posted themselves on either side of the entrance, bodies erect, pulsing a wave pattern in red and green. The glow behind them was brighter, and a shadow moved, became a silhouette heaving up to the entrance.

"Cameron," said Lael softly, "something big just filled up that tunnel entrance, and there's movement in the trees behind us."

"Stay put, Lael. Now would be a good time to start checking for odors too. Rabi, turn up the gain for sound. All this clicking and rattling is important. I'm hearing it from every direction, now. Are you getting it?"

"Yes," said Rabi, quite calmly, "and the movement isn't just behind us. It's all around the edge of Wormtown."

Cameron crawled forward several yards, flashed a long series of violet pulses, then went back to green. The response was more clicks in broken sequence, and two bright glows appeared like lamps in the tunnel entrance. Two Worms crawled down to him as he held his breath, coming within a yard, then turning, crawling, hesitating, as if beckoning him to follow. Cameron got up on his haunches and started to follow them.

"Cameron. All around us," said Lael. "I think we should pull back."

Trees moved around the edge of Wormtown as black shapes pressed forward, a circle of humped shapes waving thick appendages that clacked and rattled as they came. Cameron dialed his lamp to violet and kept it there, but continued to move forward, and remembered to take a breath.

A huge, black creature filled the tunnel entrance. Multifaceted eyes glowed brilliant green from a wedge-shaped face below a highly domed head. It squatted in the entrance, resting its face on thick appendages ending in claw-like hands with four fingers which even now rubbed lightly together to produce a soft clacking sound. The odor was sudden, penetrating Cameron's suit, thick, musky, and strangely comforting.

"Get this odor," whispered Cameron.

"Getting it," said Lael. "We can even smell it over here."

"Odor, sound, color, all used together. We'll never figure this out. Cameron, they've come out onto the dome and stopped there. They look like huge beetles, but their bodies are soft. They jiggle when they move," said Rabi. "Nearly a year on Alysia, and we've never seen these creatures."

Cameron didn't answer, switched his lamp to green and put it on the ground in front of him. He held out his arms, palms up, in what he hoped was a universal gesture of friendliness.

The creature in front of him did not move or make a sound.

Now what? Behind him there were scratching sounds, something hard

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scraping on polymer impregnated earth.

"They're moving up behind you, Cameron. There must be two dozen of them. No, now they've stopped again. For God's sake, put the guns down! One shot, and we're finished here."

Cameron had almost forgotten about the two troopers who had come with them. He reached down and dialed in a violet filter, then rapidly flashed the lamp while looking into the eyes of the creature in front of him.

There was a barrage of clicks and rattles, and the creature's eyes were alive with a pulsing pattern in green, violet and red, each facet acting like a huge pixel, it seemed. In soft, reflected light, Cameron suddenly realized the creature was not so much insect-like as it was amphibian. Beneath the eyes, two other orifices opened and closed, and there was a wide mouth with no lips. It raised one appendage and spread four long fingers apart.

"Worms coming from your left, a line of them coming out of another tunnel. They're carrying something," said Lael, then, "Here comes another black beast, Cameron, at the end of the line. God, it moves like a crab! It has something in its mouth, a white thing. Don't move! Rabi's getting all this on disk."

Cameron let out a long exhalation of breath, leaned over and dialed his handlamp back to green. Trust was a risk he had to take. His body responded by oozing sweat from every pore.

A large Worm arrived, body erect, a glistening teardrop-shaped sack in its mouth. It laid the sack within Cameron's reach and moved away. The sack was white, but transparent. Something was inside it. When Cameron leaned over to look closely, it moved.

Cameron jerked upright in surprise. His host flashed red, then green again, extended an appendage. A long finger nudged the sack closer to Cameron, and closer again. He dared to pick it up, and held his breath. Even through gloved hands he could feel new life move in the sack, and his face flushed again.

"It's a larva of some kind. Lael, it looks like a small Worm!"

"Oh, my," said Rabi. "This changes everything."

"So the Worms are their young," said Cameron, "but how—"

He put the sack back down on the ground. A Worm moved up beside it, only two feet from Cameron's face, raised its upper body and hissed softly. He leaned back just in time to see something large approaching from his right. He turned and stared into the face of another black creature coming towards him fast. It moved on four legs ending in long, four-toed feet, its appendages helping to support a heavy, glistening sack in its mouth. Its eyes glowed red, then green as it approached, laid the sack within his reach and nudged it forward with both appendages.

Cameron again dared to pick it up. It was heavy, perhaps twenty pounds. The thing inside it lay still, but was black, and he could see two large, multifaceted eyes.

"A cocoon, right?" said Rabi.

"Seems so. After metamorphosis they must be night creatures."

"Sunlight might be vital in the Worm stage," said Lael. "That's why we—"

"This is not solving our problem," said Cameron. "I have to somehow show them what our conflict is all about, and all I can use is—"

He had a sudden idea, put the sack down and again held out his arms, palms up. The beast in front of him responded with a faint rattle made with the fingers on its right appendage.

Cameron held up his lamp, flashing green, and slowly pointed to the larval sack, the cocoon, and the beast in front of him. But when he came to the Worm he pointed to it, then himself, and slowly dialed in first red, then violet, then purple into the beam of his lamp.

The only initial response was a soft glow in red, then violet, then purple from the eyes of his host. There was a

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pause of several seconds as its eyes slowly returned to green, and then it suddenly moved. Fingers rattled together on both appendages, and its eyes pulsed in a myriad of colors to form patterns from red to purple. The other black beast picked up the cocoon in its mouth and backed away. The Worms all left, including the two who had remained like sentries at the tunnel entrance.

"What happened?" asked Lael. "The Worms have all left, but the big creatures have moved up closer to you. There are a lot of color patterns being signaled back and forth."

"I was trying to show it we're afraid of the Worms, and they're dangerous to us. It seemed to—"

"Hold on. Another adult just came out of the ground to your right. I don't even see a tunnel entrance there! It has a small Worm with it. Coming right at you!"

The beast was only feet away when Cameron turned and saw it. The Worm with it was small, a three-footer, but held its upper body proudly erect. It slithered up to the creature filling the tunnel entrance, and was touched gently by a four-fingered hand. Its body glowed green, with a hint of red. The hand caressed it, reached out, touched Cameron's gloved hand, touched the Worm, nudged it forward.

Oh God, it wants me to touch it! Cameron felt a flush of heat on his face. All his sweating was making the air foul in the suit. He reached out one hand slowly. The Worm didn't flinch, but opened its mouth to show a circle of sharp teeth. Long fingers nudged it forward again. Cameron touched it; it leaned down as if to sniff the glove, flashed a soft red glow and crawled over his palm. He closed his hand slightly, felt a cylinder of firm muscle there, released it.

"I think we've just shaken hands."

"With a Worm?" said Lael.

"Through a Worm. It's as if—"

Something tapped the top of his helmet. He looked up. The beast's hand was right there, four long, hard fingers with eight knuckles. They tapped on his faceplate, reached down to the seal at his throat, tugged gently upwards.

"Uh, oh. It wants me to take off my helmet."

The Worm's body left his open hand, remained within close reach, glowing green.

"No," said Rabi. "That's moving too fast. Another time."

"One spray from that Worm, and you're dead, Cameron. We don't need that kind of trouble with the Governor's Office," added Lael.

"It's my choice. My job. I don't think there will be another chance if I don't do it now. Got that on record?"

"Yes," said Rabi softly.

"No more talk. I'm shutting off the radio until my helmet is back on. I don't want your voices frightening them." Cameron didn't wait for a reply, reached up and tapped the radio off on his helmet pad. The beast's hand was there, too, a finger of loosely connected bones rattling when he touched it.

The hand withdrew. Multifaceted eyes glowed green, though now there were touches of red, even violet in them. Cameron reached to his throat, then the back of his neck, and levered open the seal of the helmet. He felt a rush of cool air, the odor of musk and something sharper.

Even as he lifted the helmet from his head, he noticed that the Worm had begun flashing red, then violet in bright pulses. It cringed backwards from him.

The helmet was off, and he was assailed by odors. sharp and pungent. The rattling of finger bones was all around him, but it was the Worm that held his attention.

The Worm tried to back into the tunnel, but was blocked. A big hand curled gently around it, but would not let it escape. The Worm opened its mouth, and gasped for breath. It began to writhe, glowing violet, then purple. It struggled

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against the fingers holding it, and finally bit one of them, dark fluid oozing from the wound. A low moan escaped from the beast holding it.

Cameron was momentarily frozen by the rush of odors, sights and sounds. It was seconds before his higher brain kicked in, motivated by a single piece of logic.

The Worm is suffering. If I don't get my helmet back on, I will be sprayed, and I will die.

Cameron slammed his helmet back on, and scrabbled with his hands to lever the seal shut. The Worm glowed purple, writhing and prostrate the entire length of its body, but within seconds something remarkable happened. Its color changed to violet. The writhing ceased, and it lay still for a minute or so, mouth opening and closing while a long finger stroked its body. The glowing eyes of the elder who comforted it matched the colors of the young one.

Cameron suddenly felt very badly—and he understood. With his hands he made a motion to remove his helmet, then pointed to the Worm, reached down and dialed a purple filter into his handlamp. Made a motion of putting his helmet back on, and dialed green.

His host responded by repeating the colors with its eyes. There was a soft rattle of knucklebones. The Worm lifted its head, and hissed. Its body glowed red, and did not return to green while Cameron was there.

Cameron wondered what the color of sorrow was.

He needed a gesture, and could think of only one. He reached out with a gloved hand, palm up, and held it there. The eyes of his host remained green, but dimmed as it raised an appendage and spread its four fingers wide. When it closed its hand, the long fingers grasped Cameron's hand and half his forearm. Cameron squeezed gently, and was released. The creature rattled twice, turned and went back into the tunnel, showing him multijointed, muscular legs beneath a sloping back. The Worm followed, glowing red, and in a second the tunnel was black again.

Cameron turned around, saw Lael, Rabi and the two troopers sitting only feet away from him. A semicircle of dark shapes was behind them, with eyes glowing red. A few changed to green as he sat there with his strobing lamp, but then Lael pointed to the control patch on his helmet. Cameron understood, slapped at the control switches on his helmet.

"On again. Did you see all that?"

"Most of it," said Lael. "We were afraid to get much closer. You okay?"

"Fine. I'm alive, and so is the Worm."

"I don't understand why it didn't spray you if it was in real pain," said Rabi.

"My guess is it was ordered not to. I wonder if any human would put their child through such agony just to demonstrate a problem to an ignorant alien. It's some kind of allergic reaction to our odor, the chemicals in our skin, maybe even our breath."

"I can see a lifetime of work coming up on this," said Lael. "In the meantime we'll have to cover up, even in the fields. The planters aren't going to like that."

Cameron stood up. The semicircle of black creatures backed away, opening a lane for them to exit Wormtown. "It's a start. I'll try to get you some help from Portos. We certainly have proof of intelligent life here, and a species never seen before. I bet I can generate some commercial interest in this polymer that hardens the surface of their structures."

The troopers led them back up the hillock to the trail through the jungle. Cameron turned off his lamp at the edge of the earthworks. Suddenly, he was not in such a hurry to leave. His report would go out in the morning, and within two days there would be new orders for him. He would have good arguments for a long extension. As a diplomat, his mission was just beginning, and that

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was good. As a linguist, he had barely begun communication with this new species, and that was even better.

He wanted to explain to these new beings the fears of the planters, the deadly rage of a father who had lost a son, the rage of others who'd lost loved ones. He wanted to express the sorrow he felt at the agony experienced by another's child in order to solve a human problem.

He wondered if the soft-bodied, beetle-like creatures still watching him from below would understand if he pointed to his heart and flashed a purple beam of light at them with his lamp.

If purple is the color of pain and sorrow, perhaps green is the color of peace, he thought.

The others plunged ahead down the jungle trail. Cameron paused one moment to send a series of green pulses towards the rattling crowd below the hillock. His heart lifted with the chorus of green flashes they returned to him. ■

IN TIMES TO COME

Our April issue features quite a smorgasbord of fiction, some of it as deliciously silly as the season might lead you to expect, and some of it serious, intense, and thought-provoking. Pete D. Manison's "Tea With Vicky," for example, brings a new kind of immediacy to the perennial speculation about what people might do with a second chance at "might-have-beens." A new author, Scott William Carter, offers a far-future predicament in which some might see uncomfortable parallels to much more familiar events—and some disturbing questions to ponder. And, of course, we'll have the continuation of Joe Haldeman's *Camouflage*. (If some of you were puzzled over what last month's cover had to do with the story, that may now become clearer!) Richard A. Lovett offers another fact article on an odd but productive juxtaposition of sciences: "forensic seismology." Last but not least, we have another of those thoughtful and quirky musings Geoffrey A. Landis has been doing lately, this one on "Rules of Engineering Projects"—few of which you'll find in textbooks, but all of which you may find very relevant to real life.

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THE REFERENCE LIBRARY Tom Easton

Trading in Danger, Elizabeth Moon, Del Rey, $24.95, 294 pp. (ISBN: 0-345-44760-3).

One Knight Only, Peter David, Ace, $23.95, 373 pp. (ISBN: 0-441-01057-1).

Noise, Hal Clement, TOR, $23.95, 252 p. (ISBN: 0-765-30857-6).

The Ethos Effect, L. E. Modesitt, Jr., TOR, $27.95, 509 pp. (ISBN: 0-765-30802-9).

Argonaut, Stanley Schmidt, TOR, $15.95, 333 pp. (ISBN: 0-312-87726-9).

Realspace, Paul Levinson, Routledge, $21.95, 176 + xvi pp. (ISBN: 0-415-27743-3).

The Thackery T. Lambshead Pocket Guide to Eccentric & Discredited Diseases, Jeff Vandermeer and Mark Roberts, eds., Night Shade Books, $24.00, 286 + xxii pp. (ISBN: 1-892389-54-1) (signed limited hardcover available, 650 copies, $45.00, 1-892389-53-3).

Galactic Geographic Annual 3003, Karl Kofoed, Paper Tiger (distributed by Sterling), $21.95, 128 pp. (ISBN: 1-84340-070-7).

Elizabeth Moon has a reputation for strong heroines and military realism. Since she recently switched publishers, she needed a new series, with a new heroine. So here's **Trading in Danger**, starring Kylara Vatta.

Kylara's a rich kid, born to the prominent Vatta trading clan. She's also intelligent, independent-minded, and sympathetic. The first two lead her away from trading into the local military Academy, where she does quite well. The last has gotten her into trouble ever since she was a kid, for whenever someone asks for help, she gives it. At the Academy, this means cadet Mandy Rocher, who feels picked on for his religion. He asks Kylara to help him reach a chaplain of his faith, and she obliges. When it turns out that he wanted to complain and then the chaplain goes public, the Academy and the Space Service have a major PR problem.

Guess who gets the blame and the boot? Sure, there's a bit of sympathy and the Academy senior NCO gifts her with a model spaceship kit (with some odd looking parts), but she's out on her keister. And then the family wants to shove her out of sight until the fuss dies down, which means making her captain of a decrepit ship on its last mission: a few deliveries and a final stop at the wrecker's yard. Of course, being a Vatta, she looks at the ship and sees that it could be repaired with a bit of money. At the first stop, she spots an opportunity and she's off to fetch a load of Sabine agricultural machinery. Unfortunately, just as she pulls into the Sabine system, the FTL drive goes belly up. More repairs, no money, no credit, and a war breaks out around her.

What's the poor kid to do? Thanks to her aborted training, she keeps her head, plays the cards she's dealt, impresses the heck out of the mercenaries, and comes out in good shape. She even has a job offer that doesn't have much to do with trading. She also realizes that the family rather expected her to exceed the limits of her assignment—Vattas do that, don't you know?—and had

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arranged for emergency assistance in an odd sort of way. The family seems awfully stuffy and conventional, but that's only at first glance; there's a strong practicality under it all.

We'll see her again. I suspect she'll still be a trader the next time, but before long she'll be involved in military action. Moon's fans will be happy.

In *Knight Life*, Peter David got a revived King Arthur elected Mayor of New York City. Now, in **One Knight Only**, the Once and Future King is President, and he's got a mad-on for a terrorist mastermind who reminds quite deliberately of Osama.

Camelot in Washington? Yawn. Been there, done that, forty years ago. But King Arthur himself? Complete with Guinevere, or Gwen, and Percival, who has a tendency to go a-questing? Merlin a powerless statue in the Rose Garden? Why not, for Washington politics these days has a distinctly Arthurian feel to it, with the king's knights off to slay dragons and defeat black knights. All that's missing is a grail, unless you can accept the Freedom Car in that role. If you can't, David's perfectly willing to tell you about the island of Pus, where the High King, two thirds god and one third man, holds sway over a populace of immortal worshippers.

What does David need a grail for? Even as Arthur announces victory over the terrorist mastermind, an assassin's bullet strikes down Gwen. She's not dead, but the slug is in her brain and her coma seems terminal. Grief-stricken, Arthur abdicates, though not before siccing an old acquaintance on the terrorists. Meanwhile, Percival has encountered a rapidly aging refugee from Pus, tracked the island down, and been imprisoned by the High King for his unwillingness to swear fealty and live happily ever after under his thumb. He has also realized—as soon as Enkidu showed up—just who the High King really is. When he finally escapes, he brings word to Arthur, and they're all off to Pus for a final showdown.

A fun story, darkly apt for the age, and if it reads like it should be in comic-book form at times, well, David's career includes comics credits (notably for "The Incredible Hulk"), as well as *Babylon 5* and *Crusade* scripts.

Many science fiction writers have a sense of how chemistry, physics, and the other sciences fit together to define worlds and lifeforms, but in very few is that sense as strong as it is in Hal Clement. Hal has long delighted in devising worlds whose peculiarities astonish us far beyond our familiar reality but are nevertheless firmly rooted in the laws of the universe. He then writes stories to showcase those peculiarities, and if the peculiarities often seem to dominate such things as plot and character, well, that is often taken as a distinguishing feature of "hard SF."

His latest is **Noise**, and this time character plays a somewhat larger role. The setting is Kainui, a world without a scrap of land, only ocean seventeen hundred miles deep. Its colonists were assorted Polynesians, people whose history features long voyages at sea. Yet they need not live only in boats on Kainui, for they came armed with the tools of genetic engineering, and it did not take long to craft a sort of floating coral on which they could build cities. Those cities drift, and one, Muamoku, maintains a beacon to which visiting spaceships can home.

It is to this beacon that Mike Hoani, a historical linguist, comes on his mission to study the history of the colonists as it shows in the changes of their tongues. Soon he is aboard one of the local family's catamarans, observing, learning, and marveling at incessant lightning and frequent storms, periodic tsunamis (no big deal without shelves of land to ramp them up), and volcanic shock waves lensed into spouting geysers. He watches as they spot a synthetic "fish" de-

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signed to winnow iron from the sea and harvest its crop. Then a strange device—possibly of pirate make!—attaches to their hull. Impacts cause leaks. And they are adrift on a single catamaran hull while a replacement grows from the one spare seed they carry.

It's coping time, made poignant by the presence of the child 'Ao, in training to be a captain someday, made dangerous by the discovery of a new kind of "fish," and then by a slow drift toward the South Pole. Icebergs loom over them, and one proves to be so large that 'Ao at first, from her perch on the masthead, mistakes it for a city. But there is no sign of life, only a wealth of oddly shaped pieces of coral.

That's when the other ships show up. Pirates? Or something else? I'll let the author tell you, noting only that the adventure here is not of war and violence but of survival in the face of an uncaring but intricate universe. That's the way Hal plays the game: He loves science, which turns upon the Universe the minds of puzzle-solvers, and his stories star both the puzzles—which may have more than one solution—and the solvers. He also spent many years as a science educator, and he does a very nice job here of showing 'Ao's training, not just in seacraft, but in observing and interpreting—in short, in science.

Gordon Dickson once divided humanity into three subtypes: faithholders, warriors, and intellectuals. The resulting series, never completed, was perhaps best known for the Dorsai tales, centering on the warriors, but its point was the need for an eventual resolution. L. E. Modesitt, Jr., seems less optimistic. He splits humanity into those who fail to understand where lack of restraint in breeding and resource use must lead, and those who do. The latter starred in the Ecolitan series (*The Ecologic Envoy*, reviewed here in July 1987; *The Ecologic Secession*, November 1990; *The Ecolitan Enigma*, November 1997) and proved quite able warriors. In *The Parafaith War* (July 1996), the Ecolitans were replaced by the Eco-topians, who sent Trystin Desoll on an assassination mission against a theocratic empire, the Revenants, only to watch him end the war in quite another way. The alien Fahrkans, who had been prodding Desoll to think about the human tendency to put allegiance in absolutes, must have been pleased.

The Ethos Effect opens two centuries later. As Commander Van C. Albert of the Taran Republic Space Force enters Scandya system, a mysterious ship attacks. His own ship is much smaller, but Van is a resourceful fellow—he destroys it. Immediately after he is removed from command and made military attaché of the Taran embassy on Scandya, replacing an officer who supposedly drowned. Something funny is going on, and when assassins strike at the head of the Scandyan government, Van is Johnny-on-the-spot to save the day. In due time, he gets out of the hospital, collects his medals, leaves the girl behind, and goes home on forced retirement. There he finds work hard to come by and political tensions rising as his minority group is increasingly sidelined and civil liberties are threatened.

What is going on? The Revs are expanding their empire, and there are signs that they were behind the assassination attempt Van stopped. But there is something else as well, and it does not bode well for his homeland. He therefore allows himself to be recruited by Trystin Desoll (the very same one, 200 years older) as a new director for Integrated Information Systems, a foundation based in the Eco-Tech Coalition. He soon learns that IIS strives to use information to help businesses and worlds resist the Rev expansion, destroys Rev warships when it gets the chance, and has an unusual in with the Fahrkans, who remain concerned with ethics.

And there is the rub. Modesitt is concerned with the old riddle of whether

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evil means can achieve good ends. We are familiar with it today in the question of the invasion of Iraq. War is bad, but this one was undertaken in order to defeat what some saw as a great evil. Were there other means that could achieve the same end? Sanctions indirectly caused great suffering for the Iraqi people. Diplomacy was never well tried. Were there any other possibilities?

Desoll has been trying to stop Rev expansion for a long time. Now he has the power to do something decisive. Should he? If not he, who? And if his act only shifts the locus of tyranny, must Van face the same questions?

With great power comes great responsibility.

And, say the Fahrkans, great karma.

As usual, Modesitt is well worth reading.

Ye Editor of this magazine doesn't write nearly as much SF as he used to, but every once in a while he shows us that he writes just as well as any *Analog* contributor, if not in quite the same way. Last time it was *Tweedlioop*. Now it's **Argonaut**, which begins when Lester Ordway, a fellow about Stan's age, finds a strange bug in a public garden. "Cool!" he thinks. "Maybe I've found something new!" (I'm glossing, not quoting, despite the quotation marks.) So he grabs at it. And it zips to the middle of his forehead and zaps him, producing an instant life-replay. A bit later, in the ER, the doc pries his fist open and bits of the mashed bug—maybe mites?—fly up to zap the bystanders.

It doesn't take long for Lester and med-tech Pilar (who once wanted to be an astronaut) to figure out something is wrong. They find more, collect a sample, and go off to visit Maybelle, a centenarian entomologist at the American Museum, who promptly goes, "Hmm! Nanotech! Aliens spying on us! And did you hear about the aerospace plane that just blew up?"

A stranger shows up at Pilar's apartment to confirm Maybelle's guesses and say, "Ignore us, and we'll ignore you." Fat chance! The trio tries to reach the authorities, and even though phones and computers refuse to work for them they are soon in government hands, learning about the three strange ships or fleets orbiting the Earth and—Pilar especially—making suggestions about what to do.

Using nanotech in this way is an intriguing answer to a problem glossed over in most SF. As Stan notes, it's really pretty unlikely that a ship could swing into orbit and in hours or days learn more about geology, biology, climate, and so on than we have learned about Earth in centuries of effort. But drop a few assemblers on a world and let them multiply into a vast horde of eavesdroppers that send a torrent of data back to suitable computers that sort it out—that could indeed work. What happens if the natives notice? If they object? Nanotech beasties are also a great way to mess up computer chips, communication systems, and anything else electronic (or mechanical, or biological, or . . .). Government—as here—may be able to hunker down in beasty-free bunkers, but what can it do?

Stan doesn't want to say, "Nothing," for then the story would degenerate into wimpy hand-wringing. So the aliens have weaknesses that in the end reveal a surprising amount about them. Just what that is, I'll leave you to enjoy discovering.

And if you're looking for SF that would be suitable for kids—this isn't really Young Adult fiction, but there's relatively little violence and no sex—the reading level would be accessible down to, perhaps, middle school, and the inherent lessons are appropriate.

I recently wrapped up work on the sixth edition of my *Taking Sides: Clashing Views on Controversial Issues in Science, Technology, and Society* (McGraw-Hill Dushkin). This is a collection

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of paired pro/con essays on current issues; it included one pair on the social impact of being online and another on whether we should continue manned exploration of space, an issue that jumped to renewed prominence after the *Columbia* disaster.

Here's the gist of the former: When the Internet was new, its partisans promised that it would bring a new age of public participation in political decision-making and link far-flung people together to create a "global village" far more real than anything forecast for television by Marshall McLuhan. However, some people feared that it would be harmful to society. A recent PEW Internet & American Life Project study found that the optimists seem to be more nearly right: Internet users strengthen their connections to others, expand their social worlds, and increase their involvement with communities, both local and virtual, in a process called "glocalization." Other researchers say that online communication is less valuable for building strong social relationships than more traditional face-to-face and telephone communication. The overall effect depends on whether online communication replaces or supplements traditional communication.

The gist of the space-exploration issue is man vs. machine, though the latter view becomes more interesting in John Merchant's hands: he contends that the machines need not be robots, for we can use teleoperated remotes to move human presence into space without necessarily moving human bodies.

I mention these at such length because Paul Levinson's **Realspace** deals with the same issues, among others, and connects them in an interesting way. Levinson contends that we lose something crucial when we let the movement of information supplant the movement of things, that communication and transportation are no longer in their historical balance, and that we need to pay more attention to the physical side of things. Email is more human than snail mail because of its immediacy and interactivity, but "Cyberspace . . . exceeds its humanity when it challenges the core of realspace . . . where physical presence, not just exchange of information, is essential." He follows this line of thought into space, saying that for the sake of the human future we must reclaim the one-time dream of space travel and space colonies. We could profitably begin with a very symbolic statement by building a spaceport (for future, non-rocket use) on the site of the World Trade Center, whose fall brought communication and transportation poignantly together.

Realspace is an interesting book, but it would have been better if it had enjoyed the services of a competent editor. Automobiles do *not* have "combustible" engines!

Every once in a while, a small press lucks into a project that has the potential to make the major publishing houses turn green with envy in a condition known to the cognoscenti as *explosive verdigritis*. The symptoms are cries of "Who let this one escape?" and "You call yourself an editor?" leading rather promptly to terminal unemployment.

The cause of the latest outbreak of this condition is **The Thackery T. Lambshead Pocket Guide to Eccentric & Discredited Diseases**, which according to the publisher is attracting major prepublication attention only partly due to the stars (such as Neil Gaiman and Shirley Jackson) among its numerous contributors. The major reason for the buzz is that the book is quite marvelously wonky. The titular Thackery T. Lambshead is a medic born in 1900 and still busily searching out unusual and controversial diseases in odd corners of the world. Ballistic organ syndrome and Hsing's spontaneous self-flaying sarcoma are just what they sound like. Jumping monkworm, inverted drowning syndrome, Pentzler's lubriciousness, razor-

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nail bone rot . . . You may not want to know! A great many of the contributors' inventions, spelled out in thorough case descriptions, symptom lists, and putative treatments, are the sorts of things that used to make my parents say, "Tommy! Not at the table!" when I thought they made fine dinner-time conversation.

The book is of course intended as humor, but if you don't care to have flying organs, Burmese dirigible diseases, weird parasites and tumors, and internal tattoos coming up at the dinner table, keep it away from your kids.

If you can. They'll love it too!

Paper Tiger's latest SF art extravaganza is Karl Kofoed's **Galactic Geographic Annual 3003**. It's got ads for a zoo featuring life forms from all over the Milky Way, the TempDyn Prototype Temporal Module, NighTrain Tours, and the TerraTours Unirover vehicle; brief takes on several "Worlds of Wonder"; and longer essays on the airwhales of Benton 2, the effort—Project Noah—to save the life forms of Terra 2 from a collision with a rogue moon, the Cousteau Foundation's exploration of a methane sea, building spaceships from asteroids, alien drugs and music, and an encounter with a super-civilization, much of it closely enough related to let the publisher claim the book is a "graphic novel." The artwork—in several styles and media—does a nice job of making it all seem real. The text supports the artwork adequately but feels like a simplified version of what might appear in the magazine the title is modeled on.

Or is Kofoed predicting that literacy will continue to decline? Perhaps it will, but I suspect his attention centered on the graphics.

It's worth noting the jokes hiding in the *Galactic Geographic* masthead: Hal Clement works in the magazine's Tsailerol Bureau, Tsailerol Colony (which is, to be sure, Wa'yoD ta'ahre); Somtow Sucharitkul and Gardner Dozois are in the Noron Bureau, Noron Colony; and more. ■

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BRASS TACKS

Dear Dr. Schmidt,

I have been catching up on my back-issues recently, and, the second anniversary of 9/11 having just past, I have been considering the letter of Mr. Marc Russell in your July/August 2003 Brass Tacks column. He disagrees with your position in your earlier, February 2003 editorial, "Useful Illusions and Deadly Faith," that the attacks on the World Trade Center were not representative of the beliefs of most Muslims, since, if "Islam has been 'hijacked' by a small number of fanatics . . . the passengers . . . do not seem to be complaining very much."

I feel compelled to write you and make a few comments regarding his argument, as it were.

Even setting aside the common-sense aspects of why Mr. Russell's thinking doesn't hold water ("If even a significant portion of any group made up of 1.6 billion people wanted to harm Americans, 9/11 would seem mild by comparison" and so on), I still find Mr. Russell's logic poor.

By what scale does he judge "complaining"? Does he mean globally? In a religion where "church and state" are fundamentally intertwined and there is no centralized religious leader, denunciation of the attacks by the King of Jordan and the President of Pakistan and the Saudi Royal Family and so on IS strong denunciation.

Does he mean on a personal level? How many Muslims does Mr. Russell know personally, then, I wonder? I can't say, of course, but I'd hazard a guess that the answer is "none."

The bottom line is it is the duty of the ignorant to become informed, and not the burden of those who are maligned to attempt to constantly correct the misconceptions of those who don't accurately understand them or the situation.

As a Cuban-American and a Catholic, I don't feel it is my job to spend my time essentially running a PR campaign for my background. I don't spend my time attempting to explain that I am not a Communist, or involved in a drug cartel, or—in spite of recent controversies regarding my faith—tolerant of pedophilia, to every person who misguidedly thinks they know all about me or "my type." Certainly, most people know that this kind of thinking is stupid, but that's because my background is not so unusual, not because I or anyone else is constantly denouncing Castro or the behavior of certain priests. Actually becoming familiar with the people and faith Mr. Russell seems consider himself an expert on will take him much further than depending just on what he sees on TV.

Mr. Russell's brand of "logic" needs serious consideration. I can only hope that should we ever make first contact, there is nobody who thinks like Mr. Russell involved.

Should you wish to, you have my approval to print this letter.

Victor Kardex
USMC, ret.
New York, NY

Dear Stan,

I just finished reading your editorial in the September 2003 issue regarding the effects of the *Challenger* tragedy (and

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tragedies in general) on the space program. When I read the quote from Alex Roland on how any mission that we can identify can be done "more effectively" via unmanned missions, I was struck by one argument against that claim that I did not see in your editorial:

Automated, unmanned missions are notoriously ineffective at discovering something completely new.

Automated, unmanned spacecraft are sent with a limited instrument set controlled by processors designed to respond to a limited set of inputs. They are *specialized* observational tools. Such missions tend to "discover" what we expect to find. For example, if such a mission reports on the presence of particular gas in some nearby planet's atmosphere, it is because we had reason to believe that gas, or something similar, was already there and we included an instrument capable of detecting it.

To detect something completely new and unexpected, you need a *non-specialized* observational tool. And the only such tool that we know of in existence today on our planet is the trained human mind. If we don't send those tools out there, despite the risks, then we will discover nothing that is truly wondrous and unexpected. It has always been the wondrous and unexpected discoveries that offer the greatest benefits to our lives.

Clay Jones

Dear Stan,

Call me a diehard "man in space" supporter. I started reading *Analog* when I was twelve (the local public library had back issues you could check out!). I pasted "to scale" versions of the Moon and Earth on my bedroom wall and plotted the daily positions of the *Apollo* missions. I drove my motorcycle and camped overnight in the desert to watch *Columbia*'s first touchdown at Edwards. We belong in space!

On the other hand, the shuttle has always bothered me because it's not a vehicle to launch men—it's a vehicle to haul cargo. Didn't they play "Space Truckin'" during the first satellite launch mission—for a reason? The idea that we risk the lives of a number of brave men and women every time we want to launch another big communication satellite bugs the heck out of me. We need to have the capability to send men into space. We don't necessarily need to have them riding a cargo truck to get there.

Why couldn't we have kept the *Saturn*s in production, used them to haul tonnage to orbit, and developed a much smaller, cheaper, and easier-to-maintain manned orbiter a *long* time ago? If we did that, we might have weekly tourist runs to a fully functioning space station right now instead of the mess we've got! I know various plans have been on the drawing table a long time, but the resources needed to keep the shuttle going (and justify its existence) have drained away at what might have been used to develop a quick-turnaround, low maintenance "Delta Flyer."

We don't need to rehash justifications for keeping the shuttle running. We need an unmanned booster with heavy lift capabilities (buy them from the Russians if we have to!) and a smaller, faster, cheaper "people mover" to space quickly—and we need to start now!

Todd Maddison
Oceanside, CA

Dear Stan,

I approve your decision to go ahead with Edward M. Lerner's "Moonstruck" (September issue and accompanying editorial), taking note as you say of the loss of the *Columbia*. However, there is a problem which should be mentioned.

On page 11, the second page of the story, Mr. Lerner writes, "Unseen explosive bolts severed the manned orbiter from the external tank; freed from the massive orbiter, the tank and its still-attached, non-extinguishable, solid-fuel rocket boosters quickly shot clear. The

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manned orbiter coasted after them, for the moment, on momentum." But although it attempts a Return-to-Launch-Site maneuver, it is destroyed by the shock-wave of the explosion.

Unfortunately, in real life the situation would be even worse. My understanding is that there is no survivable way to separate the orbiter from the stack while the solid boosters are firing. If you take the orbiter off the external tank in that situation, it performs an uncontrolled loop, so violent as to destroy it. I say "If you take . . ." rather than "If you took . . ." because I have actually seen this happen, in an involuntary demonstration at a model rocketry display. The model orbiter came off its tank about twenty feet up and looped backwards, exactly as it's predicted that the real one would, with enough force to tear its "engines" loose.

Taking the still-burning solid boosters off the stack is no better, because in that situation the flames would almost certainly cut the wings off the orbiter. Film of the normal separation at the end of the solid burn shows how the boosters normally peel backwards, and so shows what would happen if they were still firing. When I saw the *Challenger* launched in October 1984, the boosters flew straight and true when they came off, but that's very unusual.

So there's no safe way to perform an RTLS abort until after the SRBs have shut down and preferably separated. The astronauts are well aware of this. Earlier on the same trip, I was taking part in a seminar at Big Bear Lake when the maiden flight of the *Discovery* had to be aborted, after main engine start, because of a computer problem. The late Donald Slayton, who was one of the speakers, commented, "That was not a failure. The reason for that is that when those solids fire they're going to burn for two minutes—you're going somewhere."

On p.69 of the same issue, Jeffery D. Kooistra wrote with incredulity, "One thing upon which all of the engineers seem to agree is that there was no way for the astronauts to look at the tiles while in orbit, not via a space walk, not even with a camera on a boom. And besides, we are told, even if they could look, there wasn't anything that they could do about it . . . Any kid on the planet can have a webcam on his PC, but we can't put one on the end of a stick to look at the bottom of the shuttle."

That disbelief is apt. On the STS-7 mission, Sally Ride deployed and controlled a free-flying German platform called SPAS, which took the first external photos of the shuttle in orbit. Later missions carried a free-flying platform called Spartan—which was carrying instruments to observe Haley's Comet—when it was destroyed in the loss of the *Challenger*. Several recent reports have said it has never been replaced, but in fact it was replaced and its fifth use was on the mission which took John Glenn back into orbit—it carried a solar telescope on that occasion. It might require modifications for use on the underside of the shuttle, but several experts have already called for Spartan to be fitted with tile-repairing spray-guns as well as cameras to inspect the underside for damage.

Originally, the idea was that if a problem like this developed, another orbiter would rendezvous with the damaged one and the crew equipped with spacesuits would ferry the others across in what was called a "Space Ball." Supposedly, the Space Ball would also have a heat shield and in a real emergency, could be pushed back into the atmosphere using the shuttle's remote arm.

Duncan Lunan

Dear Dr. Schmidt,

I don't think that NASA can be reformed in the manner that Jeffery D. Kooistra would like, because it exists in a larger culture of collegiality and peer review that smothers innovative thinking. This is not the culture of scientific

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rigor and ethics that your high school math teacher instilled, but the culture of a private nineteenth century men's club. In it one may never speak ill of a colleague or his work, unless in anonymous peer review, where anything goes to protects one's own interests and agendas.

This kind of privilege and prerogative is inherently intimidating and corrupting. Many fear to challenge or protest. Those who do will find themselves excommunicated from publication and funding. As a result, all the way up to the National Science Foundation, no reviewer need have any interest or ability whatsoever to follow the work which he or she judges. Any snap judgement will do, because most often the editor or program director will count only the votes. It is most rare for either to acknowledge that the reviewers were not competent and to allow a resubmission. This allows anonymous reviewers to use peer review as a bludgeon to enforce their own primacy, spending as little time as possible to grasp the work, if at all.

When science itself is commonly done in this kind of ethical atmosphere, one cannot be surprised that NASA would repeatedly fail to regulate itself to common sense and safety.

Don Baker, Ph.D.
Tulsa OK

Yes, potentials for abuse exist, but I've seen no reason to believe they're anywhere near as prevalent as you suggest. No system is perfect—what better one can you suggest?

Dear Dr. Schmidt:

In Michael A. Burstein's otherwise excellent novelette, "Paying it Forward," I was rather disappointed to see him accept the false idea that the year 2000 was the first year of the twenty-first century. Since there was no year 0, the first year of the twenty-first century had to be 2001.

Actually, this is further complicated by the fact that we are dealing with the supposed year of the birth of Jesus and that was not calculated correctly. I have seen figures that set the date from four years to as much as ten years prior to the date currently used. This means, of course, that this is actually the Christian year 2007 to as much as 2013.

Robert S. Kennedy, Jr.

I think we've already said more than enough about this, but if anyone needs a refresher on why (like it or not!) both usages are common and defensible, I suggest my January 2000 editorial, "A Double Celebration."

Dear Stan (and Bob, Greg and Martin):

This is a bit delayed due to the USPS losing my October *Analog* and my just getting a replacement from your subscription service. I thoroughly enjoyed the "Rotting Plants" Science Fact article, but have a few reservations about the concept.

1) Economics:

a. Availability of crop residues. I remember from my youth in small family dairy farm country in northern Wisconsin that there was, necessarily, a recycling mentality. The corn was harvested as a cash crop and then the corn stalks were carefully cut down, gathered up, and chopped up into silage. This was an essential food supplement for the dairy cattle to provide bulk for their diet over the winter. Every small farm had at least one or two silos for storage. Hay, mostly from native grasses, was also harvested and stored for winter use. The only cattle food that was purchased was enriched grain meal, which was carefully rationed out to the cattle. Any farmer who had to purchase hay or silage to make it through the winter lost most of his profit margin! I suppose modern commercial farming is much different, but I find it hard to believe that most crop residue is just left to rot. Where does it go now, and what would be the

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cost to obtain it for sequestering?

b. Transportation: Crop residue is, I think, relatively bulky. The cost of transport would appear to be a significant factor. Wouldn't the additional manpower, trucks, barges, ships, etc. be excessively expensive, both in terms of dollars spent to procure and to operate?

2) CO2 expense: What would be the CO2 expense of procuring additional equipment and providing all of the additional transport and non-source handing operations?

3) "Frankenresidue": Would all of this residue really sink to the bottom and disappear for 8000 years? I have horrible visions of a significant percentage of it floating around the surface and ending up on the beach. We had better be sure of the result before we dump!

In any case, the article was certainly interesting sf'nal thinking, and well worth the read.

Bob Hubbard
Winter Haven, FL

Dear Stan:

There's a simple explanation for the Fermi Paradox and the Drake Equations: maybe Einstein was right! Maybe there are no hyperdrives or wormholes, no ansibles for instant communications. Proxima Centauri is the closest star (except the Sun), and it's 4.3 light-years away.

Consider a future manned mission. Assume we could accelerate a ship at one gravity to any Newtonian speed—doubtful due to power requirements. It would take a year to reach (say) 0.5c and decelerate from it, plus eight years travel time each way, a 20-year mission. Maybe 0.1c is the best we could do, a 100-year mission. The ship has to carry enough energy and supplies to keep its crew alive for as long as it takes.

Will we find any place more interesting than the Moon there? Will we find friendly, intelligent aliens on that first shot? Or will we wait a century for the ship to bring back some rocks, and try again for a more distant star? Most stars are a lot farther away than Proxima Centauri.

It's big-time expensive to develop and build spaceships, even unmanned ones. Earth hasn't seen fit to send people to our nearest planets. One might speculate that it's even too costly to do an effective job of transmitting, or listening for, radio signals. Maybe *they haven't visited us because it's too long a trip.*

Too bad. We now know the planets don't have good science fiction aliens (i.e., Venusions as in Eric Frank Russell's "Call Him Dead" or Martians as in Robert Heinlein's *Double Star*), and we can't get to Eterna (EFR's "The Waitabits") because it's just too far away.

John P. Aurelius
Indianola, WA ■

Government is an association of men who do violence to the rest of us.

—Leo Tolstoy

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UPCOMING EVENTS Anthony Lewis

27–29 February 2004
CONDOR XI (San Diego area SF conference) at Del Mar Hilton, Del Mar CA. Guests of Honor: Robert Silverberg and Karen Haber. Registration: $40 until 15 February 2004, $45 at door. Info: ConDor, Box 15771, San Diego CA 92175; info@ConDorCon.org; www.condorcon.org

27–29 February 2004
SHEVACON 12 (Science Fiction, Fantasy, Horror and Gaming Conference of the Shenandoah Valley and Western Virginia) at Holiday Inn Tanglewood, Roanoke, VA. Writer Guest of Honor: Jim Butcher. Artist Guest of Honor: Charles Keegan. Master of Ceremonies: Rikk Jacobs. Registration: $25 until 1 February 2004; $30 at the door. Children's membership: $10 ages 8-12. Info: SheVaCon, P.O. Box 416, Verona, VA 24482-0416; themecon@juno.com; http://www.shevacon.org

5–7 March 2004
MARSCON 2004: LET'S PLAY DOCTOR (Twin Cities SF conference) at Minneapolis / St. Paul Airport Hilton, Bloomington MN. Actor Guest of Honor: Richard Biggs. Media Guest of Honor: Dr. Demento. Author Guest of Honor: John M. Ford. Fan Guest of Honor: Baron David E Romm. Artist Guest of Honor: Davina. Musical Guest of Honor: the great Luke Ski. Registration: $42 until 31 January 2004, $55 at door. Info: MarsCon, Box 21213, Eagan MN 55121; (612)724-0687; info04b@marscon.org; http://marscon.org

19–21 March 2004
STELLARCON 28 (North Carolina SF Conference) at The Radisson Hotel, High Point NC. Guest of Honor: Fred Saberhagen. Registration: $30 until 31 January 2004, then $40. Info: Stellarcon 28, 5701 Running Ridge Rd., Greensboro NC 27407; (336)294-8041; stellarcon@triad.rr.com; www.uncg.edu/student.groups/sf3/stellarcon.htm

24–28 March 2004
25TH INTERNATIONAL CONFERENCE ON THE FANTASTIC IN THE ARTS (Academic SF conference) at Ft. Lauderdale Airport Hilton, Dania FL. Theme: Global Fabulation. Guest of Honor: Daìna Chaviano; Special Guest Writer: Elizabeth Hand; Guest Scholar: Marcial Souto; Permanent Special Guest: Brian Aldiss. Registration: $85 until 1 January 2004, $100 until 15 March 2004, $125 at door. Students $45. Info: Katy Hatfield, ICFA Registrar, Box 10416, Blacksburg VA 24062; www.iafa.org

26–28 March 2004
MIDSOUTHCON 22/DEEPSOUTHCON 42 (Southern SF conference) at Holiday Inn Select, Memphis TN. Guest of Honor: David Brin; Artist Guest of Honor: Todd Lockwood; Fan Guest of Honor: Cullen Johnson; TM: Michael Sheard. Registration: $30 until 1 March 2004, $35 at door. Info: Midsouthcon, Box 11446, Memphis TN 38111-0446; (901)274-7355; fax (731)664-4320; info@midsouthcon.org; www.midsouthcon.org ■

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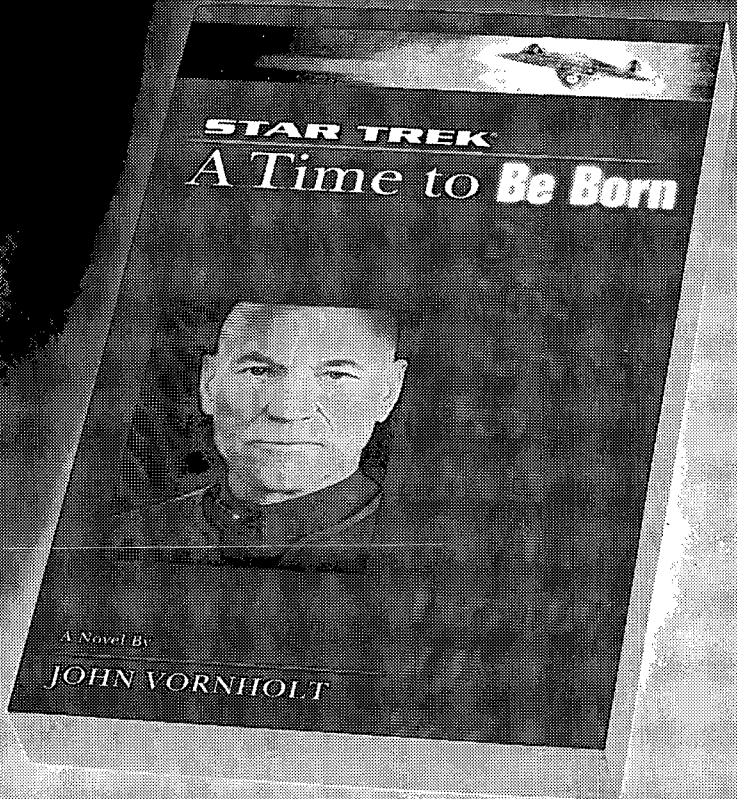

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